

## V. IMPLEMENTATION

### A. A First Step in Wildlife Conservation Planning

Development of the CWCS is an important step in setting the future direction for fish and wildlife conservation in Washington. This strategic document establishes a good biological foundation and planning framework. Further operational planning and program prioritization, at both the statewide and ecoregional scales, will need to be done to address the species and habitat priorities in the CWCS and to fully implement the strategy over time.

Although WDFW is driven by planning at many different levels, from multi-agency salmon recovery plans to individual Wildlife Area plans, creation of the State Wildlife Grants program and the CWCS requirement provided an opportunity for WDFW to undertake an agency-wide effort to reassess wildlife conservation priorities and set a new direction for the future. Specifically, the CWCS process provided the impetus for:

- a thorough reevaluation of priorities for species and habitat conservation
- a transition from statewide to ecoregional conservation
- acceleration of the evolution from species management (fine filter) to a more ecosystems-based management approach (coarse filter)
- expanding the emphasis on biodiversity conservation, at the statewide and ecoregional scales

In times of diminishing habitat resources and declining revenues for conservation it has been important for WDFW to initiate a new round of strategic planning and begin to establish new ground rules for how we prioritize species, habitats and conservation actions—and where we direct future funding and human resources to address these priorities.

### B. Narrowing the Scope of Implementation

Development of the Washington CWCS has proceeded on a parallel track with completion of ecoregional assessments (EA) for nine ecoregions within Washington (see Chapter VI, Washington's Ecoregional Conservation Strategy) during 2003, through 2005. This was a huge undertaking for WDFW. Whereas this EA process has been completed in many areas of the country, we worked as partners with The Nature Conservancy to create the EAs in tandem with the CWCS process. The CWCS was completed in the fall of 2005; the EAs are expected to be finished in 2006.

By reviewing and synthesizing hundreds of conservation planning efforts, defining and listing priority wildlife species and associated habitats, and by articulating alternative, ecoregional conservation actions, the CWCS has greatly refined the scope of Washington's implementation strategy. An initial list of thousands of species classified as wildlife in Washington was systematically narrowed to about 700, then to about 200 Species of Greatest Conservation Need and their associated habitats.



The EAs, when completed, will establish conservation targets and map biodiversity at the ecoregional level. This effort will build on the CWCS by further targeting the range of funded actions to those areas on the landscape that show the most promise for long-range, cost-effective conservation.

When taken together, these two major statewide efforts, the CWCS and the EAs, will considerably refine the scope and breadth of Washington's current statewide wildlife conservation strategy. They provide a good starting point for setting long-term and shorter-range conservation goals and objectives; identifying conservation opportunities at the statewide, regional, and local levels; and designing or redefining projects to achieve these goals and objectives. The nearly concurrent completion of the CWCS and the ecoregional assessments will position WDFW and its conservation partners to embark on a well planned and more directed approach to future wildlife conservation.

### C. Beginning the Implementation Process

While many actions have already been taken, using previous State Wildlife Grants (SWG) and other funding sources, further implementation of the Washington CWCS will begin in 2006, after it has been approved by the US Fish and Wildlife Service, and after WDFW knows how much funding is available from State Wildlife Grants (SWG), as well as other sources, to begin or resume addressing the identified conservation needs of wildlife Species of Greatest Conservation Need and associated habitats that are outlined in the CWCS.

A number of important factors will influence the initial implementation of the Washington CWCS in 2006. The first is development of the state budget. Unlike the federal government, Washington state agencies develop and implement their budgets on a biennial rather than annual basis. Washington state agencies are expected to prioritize program activities and establish performance measures each biennium, and the first review and possible revision of the CWCS will be timed to coincide with the development of the 2007-09 biennial budget.

Another important factor, discussed above, is completion of the ecoregional assessments (EA) in 2006; these are described in Chapter VI, Washington's Ecoregional Conservation Strategy. State Wildlife Grant (SWG) funds are being used in the development of these assessments, and the results of the assessments will influence how and where WDFW and its conservation partners direct their future CWCS implementation efforts and implementation funds within each ecoregion. New projects may be identified and funded to implement the CWCS, and existing SWG-funded projects may also be extended or expanded.

The initial CWCS program review and detailed implementation planning for State Wildlife Grants funding will be led by the Wildlife Diversity Division within WDFW, but will also involve other programs with WDFW. WDFW intends to reconvene and ask the CWCS Advisory Committee (See Appendix 11) to assist in shaping this process. Some of the factors to be considered include:

- The relative priority of habitat types beyond the current stratification of these areas.
- Integration of the CWCS into the 30-year Biodiversity Conservation Strategy currently being crafted by the new Washington Biodiversity Council.

- Coordination of multi-agency land acquisition through the Interagency Committee for Outdoor Recreation (IAC)
- Acceleration of coordinated conservation planning among federal and state land management agencies
- Better integration of management of marine and aquatic systems with terrestrial ecosystems, both within WDFW and among state and federal agencies.
- Incorporation of identified species and habitat conservation priorities into operational work plans within WDFW and other conservation partners. (e.g. WDFW Wildlife Program activities matrix.)
- Correlation of identified conservation actions into WDFW's cost accounting systems to assist in the development and monitoring of project budgets and relative priorities with other mandated activities.

As specific CWCS implementation needs are reviewed, projects will be designed, redefined or extended into the future to meet these needs.

#### D. Implementation Partners

Although the Washington Department of Fish and Wildlife (WDFW) has lead responsibility for administering Washington's allocation of federally-appropriated State Wildlife Grants (SWG), as well as developing, implementing and updating the Washington Comprehensive Wildlife Conservation Strategy (CWCS), the implementation of this CWCS cannot be fully accomplished by WDFW alone.

WDFW will never be adequately funded or staffed to address all the conservation problems and issues addressed in the CWCS. Even with additional funding, wildlife conservation is almost always more effective when accomplished through working partnerships with other public land management agencies, Indian tribes, conservation groups, local governments and the private sector, especially agriculture and forest landowners.

By developing a new list of Species of Greatest Conservation Need, identifying associated priority habitats, and identifying specific conservation actions, the CWCS sets up a framework for WDFW to implement comprehensive wildlife conservation in partnership with other agencies and conservation organizations.

As other public and private partners are asked to help with CWCS implementation, WDFW will consider grants to these partners to help fund these projects. How and when these grants would be made available to other partners will be determined by WDFW as part of the initial review, possible revision and implementation of the CWCS in 2006.

The following discussion identifies some of the potential roles and responsibilities of WDFW and its major potential public and private conservation partners in implementing the Washington CWCS.

#### **Washington Department of Fish and Wildlife**

Many of the statewide conservation strategies described in Chapter III, State Overview, and the conservation actions discussed in Chapter VI, Ecoregional Conservation Strategy, are primary responsibilities of WDFW. WDFW owns or manages about 840,000 acres of wildlife habitat and, within the agency's funding and

staffing capabilities, these public lands are managed to provide optimal benefit to Species of Greatest Conservation Need and associated habitats. As well as managing its own lands for fish and wildlife habitat and wildlife-related recreation, WDFW works to influence the management of other lands and waterways for maximum benefits to fish and wildlife, conducts research and surveys on priority species and habitats, enforces rules and regulations affecting wildlife and habitat, and assists local governments and landowners to identify and help protect important fish and wildlife habitat on private land. WDFW takes a lead role in many programs and activities related to fish and wildlife conservation, some of which are discussed in Chapter I, Introduction and Background; Chapter III, State Overview; and elsewhere in the Washington CWCS.

### **Other Public Land Management Agencies**

Approximately 40% of the land area of Washington state is in public ownership, and a high level of management cooperation and coordination takes place between WDFW and other federal and state land management agencies, including the Washington Department of Natural Resources, U.S. Fish and Wildlife Service, Bureau of Land Management, Bureau of Reclamation, USDA Forest Service, and the Washington State Parks and Recreation Commission. These public agencies have their own legislative mandates to conserve or at least consider fish and wildlife resources on the public lands and trust lands they manage. The Department of Defense and Department of Energy also own and manage thousands of acres of important wildlife habitat in Washington, and they conduct or participate in cooperative habitat and species conservation efforts with WDFW on Army, Navy and Air Force installations, as well as the Hanford Nuclear Reservation. WDFW works closely with these state and federal land managers on various fish and wildlife conservation issues, ranging from on-site habitat protection to invasive species control and grazing practices, and also cooperates with them on developing and conducting wildlife and habitat research and surveys.

### **Tribal Land Management Agencies**

Washington's Treaty Indian tribes are important conservation partners, and they have a potentially key role in implementing the various conservation strategies outlined in the CWCS. All Treaty tribes have some responsibility for fish and wildlife conservation on their tribal lands. Under various treaties, many also have fishing and hunting rights on public land and "co-management" responsibility for harvested fish, on and off their reservations. Some tribes such as the Yakama



Nation, Colville Confederated Tribes, and Quinault Indian Nation, control and manage vast areas of wildlife habitat on their reservations. As with federal and state agencies, as well as private landowners, WDFW may need to expand its existing coordination efforts with the tribes to ensure that CWCS species and habitat priorities are recognized and addressed on tribal lands and co-management areas on public land.

### **Private Forest Landowners**

Approximately 36 percent of Washington's forested land area is owned and managed by private forest landowners. WDFW works closely with these companies to try to

ensure that forest practices are compatible with sound management of wildlife species and habitats, and to promote responsible public recreational access to these private lands. Coordination with large private landowners often takes place within the regulatory context of the federal Endangered Species Act (ESA) or the Washington Forest Practices Act, although much cooperative wildlife research and management also occurs on private lands without any regulatory requirement. WDFW works cooperatively with private forest landowners through the Washington Forest Practices Board and the Forest and Fish Agreement on policies and measures to conserve fish, wildlife and habitat on private forestlands. Many forest landowners have also adopted Habitat Conservation Plans (HCP) with federal fish and wildlife agencies to protect ESA-listed fish, wildlife and associated habitats.

### **Local Governments**

Washington's cities and counties have a key role in identifying and protecting critical fish and wildlife habitat on private lands. Cities and counties have always done comprehensive land use planning, but their conservation responsibilities were greatly expanded with passage of Washington's Growth Management Act (GMA) by the State Legislature in 1990. Under the Act, amended in 1995, cities and counties must use "best available science" to identify and protect the values and functions of "critical areas", which are defined in the GMA to include wetlands and "fish and wildlife habitat conservation areas".

Upon completion of the CWCS and the ecoregional assessments described in Chapter VI, Washington's Ecoregional Conservation Strategy, WDFW will expand its efforts to help local governments use "best available science" in protecting important habitat. This will be done by providing good habitat mapping products to local planners and by working with them to ensure that their local GMA plans, as well as other local conservation programs such as "conservation futures" and open space property tax incentives, address the Species of Greatest Conservation Need, associated habitats, and conservation actions identified in the CWCS.

This effort to provide local habitat assessments to local governments is discussed again, to include links to county pilot projects, in Chapter III, State Overview.

### **Other Public and Private Conservation Partners**

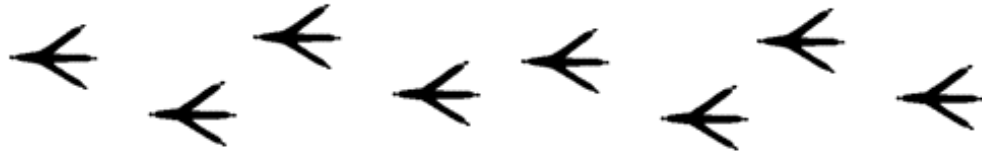
WDFW works with many other public agencies, private conservation groups and private individuals on wildlife conservation and recreation issues, and many of these agencies and organizations will be asked to partner with WDFW in implementing the Washington CWCS. WDFW is also actively involved in a number of public-private conservation partnerships such as the Salmon Recovery Funding Board and the Pacific and Intermountain West Joint Ventures (for migratory birds).

Although they do not manage large areas of habitat, federal agencies such as the National Marine Fisheries Service and Environmental Protection Agency do have regulatory responsibility for anadromous fish, marine mammals and wetlands. Washington state agencies such as the Department of Ecology, Department of Transportation, Puget Sound Action Team, and the Office of the Superintendent of Public Instruction also have conservation and education responsibilities that may be effectively applied to the implementation of the CWCS. Local conservation districts, irrigation districts, land trusts and weed boards are important potential partners in

addressing problems such as habitat fragmentation and invasive species, which are discussed at both the ecoregional and local levels in the CWCS.

Some of WDFW's most important conservation partners are various nonprofit conservation and wildlife recreation groups and coalitions such as The Nature Conservancy, Audubon Washington, Trust for Public Land, Washington Wildlife Federation, Trout Unlimited, Rocky Mountain Elk Foundation, Ducks Unlimited, Partners In Flight, Defenders of Wildlife and various local and regional land trusts. All of these groups, and many others, are potential partners in implementing the CWCS, through projects as varied as creating the new Pacific Education Institute, to surveying neotropical migratory birds, to restoring and enhancing habitat on public lands.

Some of WDFW's conservation partners, including many state and federal agencies, have broad conservation mandates. The role of other agencies and conservation organizations is more narrowly defined. The following matrix, while not intended to be complete or inclusive, tries to associate major responsibilities of some of these public and private partners with the statewide fish and wildlife conservation strategies discussed in Chapter III, State Overview. This loose association hopefully gives some indication of which conservation partners, other than WDFW, might be asked to help implement certain elements or recommendations in the CWCS.



OTHER PUBLIC LAND MANAGEMENT AGENCIES											
CONSERVATION ACTIONS*	WDFW	DNR	USFWS	BLM	BUREAU OF RECLAM.	USDA FS	WA PARKS & RECREATION	WASHINGTON INDIAN TRIBES	PRIVATE LANDOWNERS	LOCAL GOVERNMENTS	OTHER CONSERVATION PARTNERS
Species conservation strategies	X		X					X			X
Coordinated salmon recovery	X	X				X	X	X	X	X	X
Habitat conservation on public lands and waterways	X	X	X	X	X	X	X			X	X
Habitat conservation on private lands	X								X	X	X
Habitat acquisition	X	X	X	X						X	X
Research, monitoring and surveys of fish, wildlife and habitat	X	X	X	X		X		X			X
Direct enforcement of state laws to protect fish, wildlife and habitat	X	X									

OTHER PUBLIC LAND MANAGEMENT AGENCIES											
CONSERVATION ACTIONS*	WDFW	DNR	USFWS	BLM	BUREAU OF RECLAM.	USDA FS	WA PARKS & RECREATION	WASHINGTON INDIAN TRIBES	PRIVATE LANDOWNERS	LOCAL GOVERNMENTS	OTHER CONSERVATION PARTNERS
Indirect enforcement of local, state and federal laws to protect fish, wildlife and habitat	X	X	X			X	X	X			
Wildlife information and conservation education	X	X	X	X	X	X	X				X
Wildlife recreation programs	X		X					X			
Harvest management	X		X					X			
Forest practices management	X	X	X	X	X	X			X	X	X
Biological assessment, local planning and information services	X	X	X					X		X	X

\* Primary or key conservation actions.



## VI. ECOREGIONS: WASHINGTON'S ECOREGIONAL CONSERVATION STRATEGY

### A. Why Ecoregions?

Even the untrained eye will notice that Washington's natural vegetation exhibits regional differences. Lands west of the Cascade Crest are dominated by forest, but lands in the center of Washington have no forest at all; they are covered with sage shrubs and grasses. Forests on the western slopes of the Cascades are dominated by western hemlock and Douglas-fir. Forests on the eastern slopes are dominated by a very different tree species—ponderosa pine. The regional differences in vegetation cause regional variation in wildlife species, and collectively, these regional differences in both vegetation and wildlife manifest regional variation in biodiversity.

These obvious differences in regional vegetation and biodiversity led to the concept of ecoregions, which are defined as relatively large areas of land and water that contain geographically distinct assemblages of natural communities. These communities 1) share a large majority of their species, dynamics, and environmental conditions, and 2) function together effectively as a conservation unit at global and continental scales. Most ecoregions in North America span millions of acres across multiple states or provinces. They provide a useful framework for cooperating with federal agencies, neighboring states and Canadian provinces on conservation planning.

For purposes of conservation assessment and planning, The Nature Conservancy, the Washington Natural Heritage Program and WDFW have adopted ecoregions for landscape-level planning because they provide an ecological basis for partitioning the state into coherent units that circumscribe common habitat types, wildlife species, stakeholders, land uses, and various conservation issues across geopolitical boundaries. Local decisions with regard to preserving biodiversity will be most effective when made within the context of a broader, ecoregional-scale conservation strategy.

The Nature Conservancy adapted the USDA Forest Service ECOMAP framework as the base map for all ecoregional assessment work in the United States. For the Washington ecoregional assessments, slight modifications to the boundaries were made by the Washington Natural Heritage Program using local data and boundaries developed by the U.S. Environmental Protection Agency in 2000. As shown in Figure 11 below, portions of nine ecoregions occur within Washington.

Figure 11. Washington's ecoregions.



#### B. Ecoregional Assessments

Limited resources, as well as social and economic considerations, make protection of all wildlife habitats impractical. To be effective, conservation must efficiently use limited resources. Addressing this predicament requires a reliable method for prioritizing potential conservation areas. To guide biodiversity conservation and inform land use planning across the state, WDFW and the Washington Department of Natural Resources joined The Nature Conservancy to complete ecoregional assessments (EA) for each of Washington's nine ecoregions. The East Cascades and West Cascades ecoregions were combined into one assessment. These eight EAs attempt to identify and prioritize places for the conservation of all biodiversity in an ecoregion. The relative priority of places is based on such factors as species rarity, species richness, species representation, site suitability and overall efficiency. They do not replace individual species recovery or management plans, or any other species-based or habitat-based planning, but are designed to ensure that the highest priority biodiversity sites are identified and protected.

Ecoregional assessments are one decision support tool that can be used to help implement the CWCS. The main products of these assessments are a comprehensive compilation of conservation data for the ecoregion, a conservation utility map, and a conservation portfolio map. These maps and the data used to recreate them can guide cost efficient conservation efforts at various scales on both public and private land. The primary uses of these maps are 1) prioritizing potential land acquisitions and conservation easements, 2) rating grant proposals for habitat protection or

restoration, and 3) informing local planners for the purposes of county comprehensive plans and other local planning projects.

WDFW will use the ecoregional assessments to help guide statewide conservation strategies as well as the conservation actions listed in the ecoregional chapters of the CWCS. Focusing conservation effort in the higher priority conservation areas within each ecoregion will do the most good for the greatest number of wildlife species and habitats of concern.

Toward this end, Conservation Utility Maps, which display relative conservation value across a whole ecoregion, are included in the CWCS for three representative ecoregions, the Okanogan, Northwest Coast, and Puget Trough. WDFW recognizes that the landscapes or watersheds with the highest value on these conservation utility maps are the logical starting places for implementing biodiversity conservation, while acknowledging that conservation efforts for individual Species of Greatest Conservation Need (SGCN) should be first be conducted in the areas identified in various species recovery and management plans.

All of the ecoregional assessments will be completed by year-end 2006, and will be posted on the WDFW website as they become available. For a more detailed description of the ecoregional assessment process and products, see Appendix 12.

#### C. Local Conservation Planning

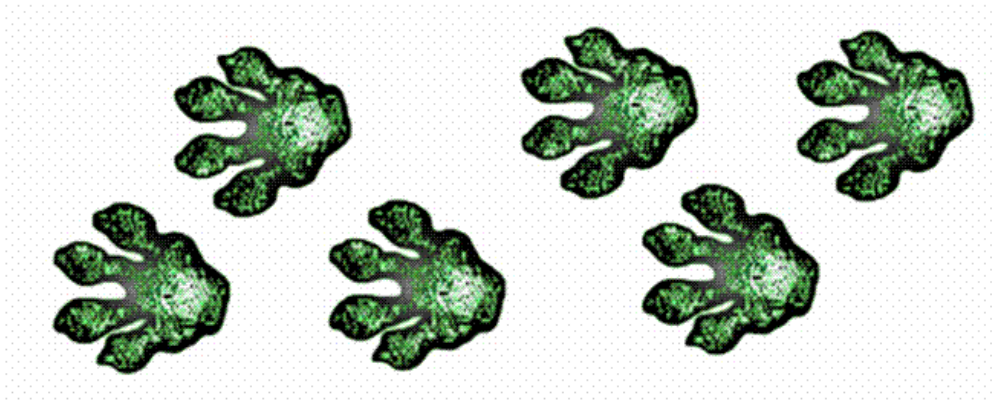
Efficient conservation strategies should begin at a regional level, but conservation decisions and actions are increasingly occurring at the local level, and local conservation efforts can be more effective when made within the context of a broader, regional-scale strategy. However, since ecoregional assessments cover huge areas, they cannot adequately address all fish and wildlife resources important to local governments and citizens. Consequently, WDFW is also using the products from ecoregional assessments to develop local habitat assessments, which will identify the relative value of wildlife habitats across an entire county.

This process combines local information with ecoregional priorities to assist in county land use planning. Local habitat assessments will provide citizens and officials with a better understanding of the relative value of wildlife resources across their county, as well as the potential contribution of an area to regional biodiversity. WDFW field biologists can use the local assessments, as well as the information provided in the following ecoregional chapters of the CWCS, to help prioritize their work and provide technical assistance to local and regional conservation projects.

#### D. Ecoregional Conservation Strategies

Washington's CWCS is organized at both statewide and ecoregional scales in order to help WDFW and its conservation partners be as strategic as possible in confronting the challenges of conserving Washington's wildlife diversity. While some information is repeated in several of the ecoregional chapters included below, this is intentional so that each ecoregional chapter can stand alone. Most of the information included in the following ecoregional chapters is drawn from completed ecoregional assessments as well as other plans and assessments listed for each ecoregion. All ecoregional chapters contain the following elements:

- Map showing the ecoregion's location in Washington
- Discussion of physiography and land ownership
- Conservation Utility Map for the ecoregion (where they are completed)
- Map of land ownership
- Major conservation partners, plans and assessments
- List of Species of Greatest Conservation Need
- Description of habitats in greatest need of conservation
- Map of habitat types
- Major problems and management issues
- Recommended conservation actions



## NORTHWEST COAST ECOREGION



### PHYSIOGRAPHY AND FISH AND WILDLIFE DIVERSITY

#### Geography

The Northwest Coast ecoregion includes most of the Olympic Peninsula of Washington, the coast mountain ranges (including the Willapa Hills) extending down to central Oregon, and most of Vancouver Island in British Columbia. Approximately 11 percent of Washington is within this ecoregion. A majority of the Washington portion has been converted to timber management, agricultural or urban uses.

The Olympic Mountains, the ocean coast and coastal plain, and the Willapa Hills are the ecoregion's dominant landforms. Glaciated peaks in the Olympic Mountains rise to an elevation of nearly 8,000 feet above sea level. Streams and rivers typically begin as deeply incised, steep gradient drainages that eventually feed large, low-gradient river systems on the coastal plain. The coastal plain is up to 20 miles wide on the west side of the Olympic Peninsula and mostly underlain by glacial till and outwash. Major estuaries and associated dunes are found on the southern coast. The Willapa Hills mountain range consists of worn highlands with old, well-weathered soils.

#### Geology

Viewed from above, the mountains of the Olympic Peninsula seem to present a disorganized, circular array of jagged peaks above a deep, forested labyrinth of canyons, but the dominant design is controlled by 11 major rivers radiating from the mountains like the spokes of a wheel. This topography shows that the Olympics developed as a separate uplift, not as part of a long, coastal mountain chain. They comprise a massif in themselves. Between the major rivers in the core of the range are extensive tracts of alpine and subalpine terrain: flowered meadows, barren rocky expanses, and glacial ice.

In the southern half of the ecoregion, the Willapa Hills have rounded topography and deep weathering profiles. Erosion carved these hills into a deep slab of oceanic crust that still lies almost as flat as it formed. During the Pleistocene, a major river existed in the present-day valley of the Chehalis River. This glacial-age river channeled melt waters from the western foothills of the Cascades and the southernmost extent of the Puget lobe towards the Pacific Ocean.

## Climate

High precipitation typifies the ecoregion, averaging 60 to 240 inches annually (some of the highest levels on earth). Most precipitation falls as rain from November through April. Snow pack and rain-on-snow zones cover a considerable area in the Olympic Mountains. Due to the rain shadow effect, the northeastern Olympic Mountains receive the lowest precipitation of equivalent elevations anywhere in western Washington. Along the outer coast and adjacent valleys, fog and cool temperatures in the summer are important climatic factors.

## Habitat and Plant Associations

The forests in this ecoregion are among the most productive in the world, characterized by large trees, substantial woody debris, luxuriant growth of mosses and lichens on trees, and abundant ferns and herbs on the forest floor. Coniferous forests dominate the vegetation. The most widespread forest type is dominated by Douglas-fir, western hemlock and western redcedar. Douglas-fir is the most common tree at lower elevations, but is an early seral species; western hemlock is the climax species in many of the same lowland areas. These forests occur from sea level up to elevations of 2200-3200 feet in the Coast Range and Olympic Mountains. This forest type occupies a wide range of environments with variable composition and structure and includes such other species as grand fir, Sitka spruce and western white pine.

While hemlock and fir dominate much of the ecoregion, cool and wet conditions along the coast create a narrow band of forests distinguished by Sitka spruce. With its high tolerance of salt spray, Sitka spruce may form nearly pure forests or co-dominate with lodgepole pine in areas near the ocean. Forests in the mountains are mostly dominated by Pacific silver fir and mountain or western hemlock. High elevations in the Olympic Mountains have subalpine parkland and alpine habitats.

Riparian forests of this ecoregion are quite distinct from the Douglas-fir/hemlock forests. Broadleaf species such as black cottonwood and red alder replace the otherwise ubiquitous conifers along the many rivers and streams. Occasional native grasslands, sand dune and strand communities, rush meadows and marshes, and western redcedar and alder swamps, often formed by beaver activity, break up the conifer forests.

## Fish and Wildlife Diversity

The Northwest Coast ecoregion has not experienced the rapid population growth of the Puget Trough ecoregion and still retains a high level of biodiversity. The region's temperate coniferous forests rank among the richest in the world in terms of forest and wildlife diversity. The Olympic Mountains are rich in rare plant species due to their isolation, the number of unusual habitats, and the presence of steep environmental gradients. Among the rare and endangered species in this ecoregion are the Oregon silverspot butterfly, sea otter, Pacific fisher (extirpated), snowy plover, marbled murrelet and northern spotted owl. The Olympic Coast National Marine Sanctuary, consisting of 3310 square miles of marine waters off the coast of Washington's Olympic Peninsula, contains rocky and sandy shores, kelp forests, sea stacks, islands and open ocean. The Sanctuary harbors more kinds of kelp than anywhere else in the world and a large variety of migratory fish, seabirds and marine mammals. Willapa Bay and Grays Harbor, the second and third largest estuaries on North America's west coast, also contribute to the biodiversity of the Northwest Coast ecoregion. Both of these estuaries are critical migratory stopover sites for shorebirds, Pacific brant, and

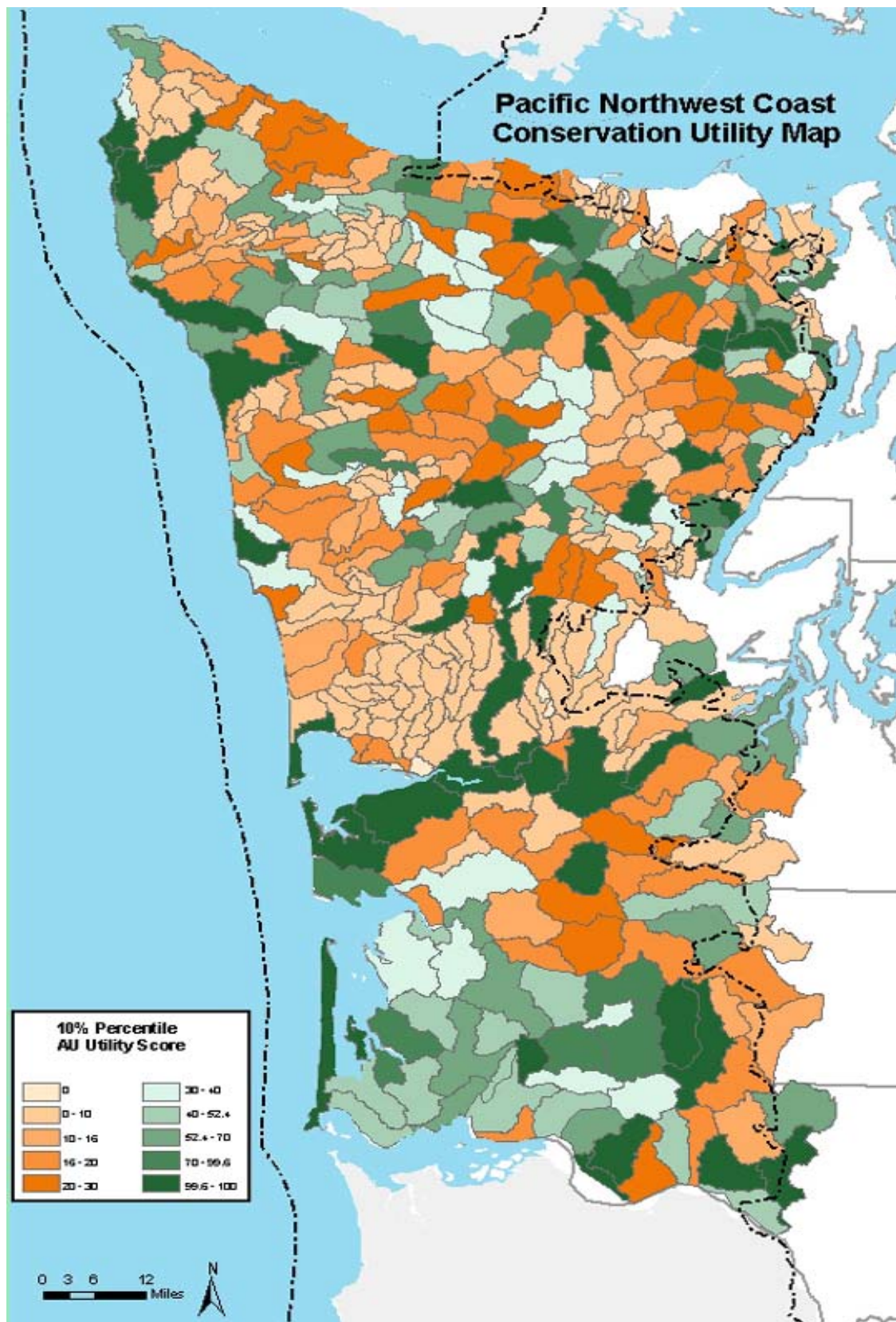


other migratory birds. Other habitats that contribute to biodiversity include coastal dunes, mud flats, wetlands and sphagnum bogs. Roosevelt elk, blacktail deer, black bear and cougar were not abundant in coastal Douglas-fir forest until settlement by European Americans and forest harvest resulted in fewer old-growth forests and an increase in earlier forest successional stages. Large marine mammals, including the California gray whale, Steller sea lion, sea otter and harbor seal are found in adjacent waters of the Pacific Ocean.



While the CWCS focuses on wildlife diversity, the ecoregional assessments address the full range of Washington's biological diversity. One product of the ecoregional assessment, the conservation utility map, depicts the relative biodiversity value of landscapes or watersheds within the ecoregion. A sample map, titled Conservation Utility Scores, is shown below for the Northwest Coast ecoregion (Figure 12). The utility scores indicate both the biodiversity value of an assessment unit (AU) and its suitability for conservation. The AU varies by ecoregion and is either a hexagon or a watershed. The scores are generated with a computer algorithm under the assumption that all AUs are not equally suitable for conservation (a suitability index was used). For instance, lands adjacent to intensive agriculture or residential development are considered less suitable for conservation than lands adjacent to undisturbed forest. The algorithm assigns a high utility score to AUs that contain rare targets (species or communities), contain a large amount of a target (i.e., has high representation of a target), or has a high number of targets (i.e., has high richness). When a set of AUs have similar biological contents, the algorithm uses the suitability index to choose the best AU from the set. AUs with a score of 100 are either irreplaceable or are the most suitable place to conserve particular targets. Refer to Appendix 12 for a description of how these maps were developed.

Figure 12.





## **LAND OWNERSHIP**

Over half of the Northwest Coast ecoregion is privately owned, with commercial timber companies making up a large portion of this private land. Approximately 31 percent is managed by six federal agencies (USDA Forest Service, National Park Service, U.S. Fish and Wildlife Service, Department of Defense, and U.S. Army Corps of Engineers), with the Forest Service (Olympic National Forest) making up nearly half. Around 12 percent of the region is public trust land managed by the Washington Department of Natural Resources or county governments, with the remaining two percent under tribal ownership and management, primarily the Quinault and Makah Indian tribes.

Dominant land use is commercial forestry. Sport fishing, hunting and hiking are common recreational pursuits. Harvest of specialty forest products, such as mushrooms, ferns, salal, mosses and lichens is increasing. Small communities and tourism dominate coastal areas. The only metropolitan area in the ecoregion is Aberdeen-Hoquiam in Grays Harbor County. Other coastal communities include Long Beach and the Raymond-South Bend area in Pacific County. Population numbers in Westport and Ocean Shores in Grays Harbor County appear to be on the verge of a major increase.

The largest protected area in the ecoregion is Olympic National Park and the surrounding wilderness areas in the Olympic National Forest. The majority of the protected area lies at higher elevations. Logging and other human activities have significantly altered nearly all habitats outside the national park. Figure 13 maps land ownership classes for the Northwest Coast ecoregion.

# Pacific Northwest Coast Ecoregion

## Land Ownership Classes

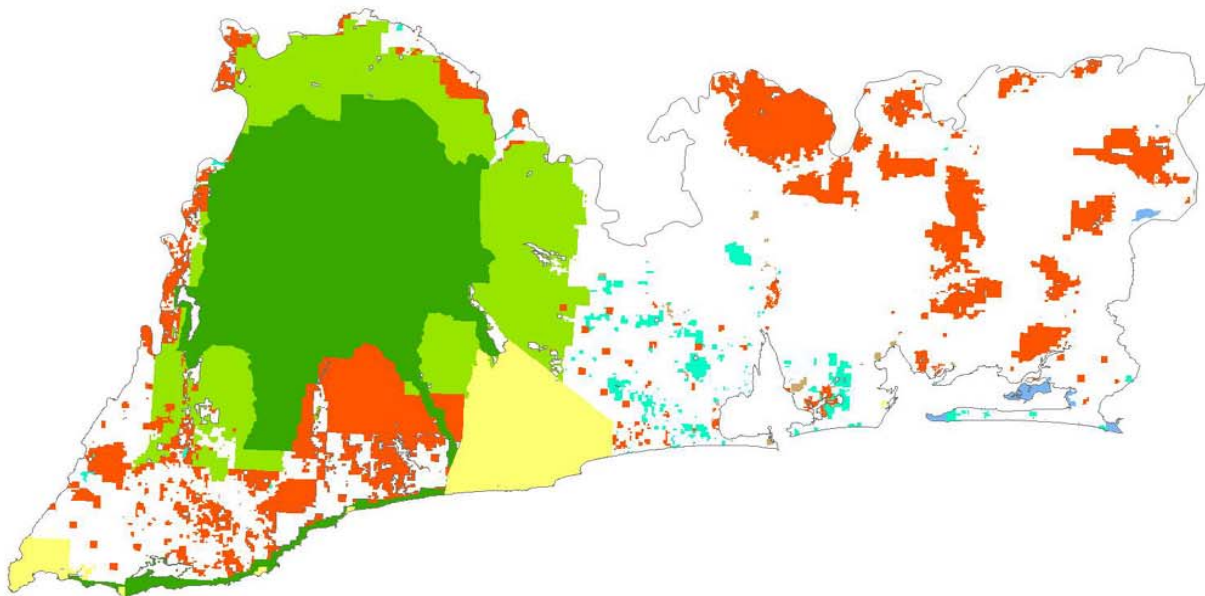
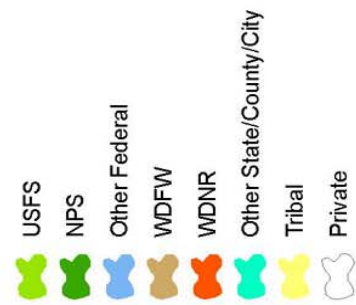


Figure 13.

## ECOREGIONAL CONSERVATION PARTNERSHIPS

Effective conservation of fish, wildlife and biodiversity in Washington requires close coordination and cooperation with many public and private conservation partners. Major partners in the Northwest Coast ecoregion include:

- Makah Indian Tribe
- National Park Service (Olympic National Park)
- Quinault Indian Nation
- U.S. Fish and Wildlife Service
- USDA Forest Service (Olympic National Forest)
- Washington Department of Agriculture
- Washington Department of Natural Resources (WDNR)
- Washington Parks and Recreation Commission

The Washington Department of Fish and Wildlife also works closely on conservation projects with private conservation partners such as The Nature Conservancy, Trust for Public Land, Trout Unlimited, Audubon Washington, Ducks Unlimited, Pacific Coast Joint Venture and a growing number of fisheries enhancement groups and local land trusts.

### Major Plans and Assessments

A number of ongoing or completed planning efforts involving WDFW and its public and private partners guide the conservation and management of fish and wildlife resources statewide and in the Northwest Coast ecoregion. Important planning efforts affecting conservation in the Northwest Coast ecoregion include:

- Forest Practices Habitat Conservation Plan (WDNR)
- Grays Harbor Estuary Management Plan
- Lower Columbia River Estuary Program
- National Estuary Program (NEP) Comprehensive Conservation Management Plan
- NOAA Fisheries Draft Killer Whale Conservation Plan (2005)
- Northwest Coast Ecoregional Assessment
- Northwest Forest Plan (1994)
- Pacific County Dune Management Plan
- USFWS Columbian White-tailed Deer Recovery Plan (1983)
- USFWS Draft Bull Trout Coastal/Puget Sound DPS Recovery Plan (2004)
- USFWS Draft Northern Spotted Owl Recovery Plan (1992)
- USFWS Marbled Murrelet Recovery Plan (1997)
- USFWS Oregon Silverspot Butterfly Recovery Plan (2001)
- Washington Forest and Fish Agreement (1999)
- Washington Forest Practices Board Wildlife Strategy (in progress)
- Washington State Coastal Zone Management Plan
- WDFW Aquatic Nuisance Species Management Plan
- WDFW Bald Eagle Status Report (2001)
- WDFW Bull Trout and Dolly Varden Management Plan (2000)
- WDFW Common Loon Status Report (2000)
- WDFW Fisher Recovery Plan (2004)
- WDFW Fisher Status Report (1998)
- WDFW Forage Fish Management Plan (1998)
- WDFW Killer Whale Status Report (2004)
- WDFW Marbled Murrelet Status Report (1993)

- WDFW Draft Mazama Pocket Gopher, Streaked Horned Lark and Taylor's Checkerspot Status Report (2005)
- WDFW Draft Northwest Coast Regional Wildlife Area Management Plan
- WDFW Olympic Mudminnow Status Report (1999)
- WDFW Outline for Salmon Recovery Plans (2003)
- WDFW Peregrine Falcon Status Report (2002)
- WDFW Sea Otter Recovery Plan (2004)
- WDFW Snowy Plover Recovery Plan (1995)
- WDFW Steller (Northern) Sea Lion Status Report (1993)
- WFW Pygmy Whitefish Status Report (1998)

Supporting references to these and other important statewide planning documents are included at the end of this chapter and/or in Appendices 6 and 7.

## SPECIES AND HABITATS OF GREATEST CONSERVATION NEED

This section provides a short summary of priority species and associated habitats for the Washington portion of the Northwest Coast ecoregion.

### Species of Greatest Conservation Need

The following species list for the Northwest Coast ecoregion is a regional subset of the statewide Species of Greatest Conservation Need (SGCN) list shown in Appendices 1 and 2. The process and criteria used to develop the statewide SGCN list are provided in Volume Two, Approach and Methods, as well as in Appendix 3. Species listed below are found in the Northwest Coast ecoregion for all or part of their lifecycle. Supporting tables and information for these species and habitats can be found in Chapter IV and Appendices 1, 2, 8, 9, 10 and 14.

COMMON NAME	Population Size/Status						Population Trend				State Status*	WNHP
	Extirpated	Critical	Low	Medium	Abundant	Unknown	Declining	Stable	Increasing	Unknown		
<b>Mammals</b>												
Keen's myotis						x				x	C	S1
Townsend's big-eared bat			x							x	C	S3
Olympic marmot			x							x	N	S3
Mazama (western) pocket gopher			x				x				C	S2
Killer whale			x				x				E	S1
Pacific harbor porpoise			x							x	C	G4
Gray wolf (historic)	?									x	E	S1
Steller sea lion			x				x				T	S2
Marten			x				x				G	S4
Fisher	x							x			E	SH
Sea otter			x						x		E	S2
Columbian white-tailed deer			x						x		E	S1
<b>Birds</b>												
Common loon			x					x			S	S2
Western grebe			x				x				C	S3
Great blue heron			x							x	M	S4
Trumpeter swan			x						x		G	S3
Tule greater white-fronted goose			x							x	G	S3
Brant			x				x				G	S3
Northern pintail					x		x				G	S3
Greater scaup				x							G	S5
Lesser scaup				x			x				G	S4

COMMON NAME	Population Size/Status						Population Trend				State Status*	WNHP
	Extirpated	Critical	Low	Medium	Abundant	Unknown	Declining	Stable	Increasing	Unknown		
Long-tailed duck			x				x				N	S3
Black scoter			x				x				G	S4
Surf scoter				x			x				G	S3
Bald eagle				x					x		T	S4
Northern goshawk			x							x	C	S3
Golden eagle			x							x	C	S3
Peregrine falcon			x						x		S	S2
Snowy plover			x						x		T	S1
Black oystercatcher			x					x			M	S4
Willet			x							x	N	S3
Marbled godwit			x							x	N	S3
Red knot			x				x				N	S3
Rock sandpiper			x				x				N	S3
Arctic tern						x				x	M	S2
Common murre				x			x				C	S4
Marbled murrelet			x				x				T	S3
Ancient murrelet			x							x	N	S3
Cassin's auklet				x			x				C	S3
Tufted puffin			x				x				C	S3
Northern spotted owl			x				x				E	S1
Vaux's swift			x				x				C	S3
Pileated woodpecker				x						x	C	S4
Streaked horned lark		x								x	N	S1
Purple martin			x					x			C	S3
Western bluebird			x				x				M	S3
<b>Amphibians</b>												
Dunn's salamander			x							x	C	S2
Van Dyke's salamander			x							x	C	S3
Columbia torrent salamander				x						x	C	S3
Western toad				x			x				C	S3
<b>Fish</b>												
River lamprey						x				x	C	S2
Pacific lamprey						x				x	N	S3
Copper rockfish		x						x			C	

COMMON NAME	Population Size/Status						Population Trend				State Status*	WNHP
	Extirpated	Critical	Low	Medium	Abundant	Unknown	Declining	Stable	Increasing	Unknown		
Greenstriped rockfish						x				x	C	
Quillback rockfish		x						x			C	
China rockfish						x				x	C	
Tiger rockfish						x				x	C	
Bocaccio rockfish		x								x	C	
Canary rockfish			x							x	C	
Redstripe rockfish						x				x	C	
Yelloweye rockfish		x								x	C	
Green sturgeon				x			x				G	S2
Bull trout						x				x	C	G3
Pygmy whitefish						x				x	S	S1
Eulachon		?								x	C	S4
Ozette sockeye											C	G5
Lake Pleasant sockeye											G	G5
Lower Columbia steelhead											C	G5
Lower Columbia coho											G	G4
Olympic mudminnow						x				x	S	S2
Surfsmelt				x						x	G	G5
Pacific sand lance					x					x	N	
<b>Invertebrates</b>												
Siuslaw sand tiger beetle			x							x	N	S3
Dog star skipper (butterfly)						x				x	N	S2
Makah (Queen Charlotte) copper (butterfly)			x							x	C	S2
Johnson's hairstreak (butterfly)						x				x	C	S2
Puget (Blackmore's) blue (butterfly)			x				x				N	S2
Puget Sound fritillary (butterfly)						x	x				N	S3
Oregon silverspot (butterfly)	x									x	E	SX
Valley silverspot (butterfly)			x				x				C	S2
Western floater (bivalve)			x				x				N	S4
Winged floater (bivalve)			x				x				N	G3
Oregon floater (bivalve)			x				x				N	S3
Western ridged mussel			x				x				N	S2
Western pearlshell				x			x				N	S4
Crowned tightcoil (snail)	?									x	N	S1

COMMON NAME	Population Size/Status						Population Trend				State Status*	WNHP
	Extirpated	Critical	Low	Medium	Abundant	Unknown	Declining	Stable	Increasing	Unknown		
Oregon megomphix (snail)			x				x				N	G2

\* Status Codes

E = endangered

T = threatened

S = sensitive

C = candidate

M = monitor

\*\* WNHP Codes (S = state, G = global)

1 = critically imperiled

2 = imperiled

3 = vulnerable to extirpation or extinction

4 = apparently secure

5 = demonstrably widespread, abundant and secure

### Species Conservation in the Northwest Coast Ecoregion

Species of Greatest Conservation Need (SGCN) found in the Northwest Coast ecoregion (see table above) include those classified by WDFW as Endangered, Threatened, Candidate or Monitor species, as well as species identified by WDFW as needing additional research or funding attention. Conservation actions are recommended for these SGCN species at both the statewide and ecoregional levels. These recommended conservation actions are summarized in a series of matrices included in Chapter IV and as Appendices 9 and 10. These matrices also display the life history, population status and distribution of these species.

### Ecoregional Habitat Overview

Although preservation of old growth forest has been a dominant issue in terrestrial wildlife conservation in the Northwest Coast ecoregion during the last 20 years, many other non-forested habitats and associated species are also in peril and are often overlooked. Special habitats such as dunes, estuaries, headlands, native grasslands and wetlands are threatened by timber harvest and land development in the region. The Oregon silverspot butterfly is an example of non-forest species that are extremely rare and vulnerable wherever they occur. Figure 14 maps wildlife habitat classes for the Northwest Coast ecoregion.



The following habitat types classified, coded and described in Wildlife and Habitat Relationships in Oregon and Washington (WHROW), are present in the Northwest Coast ecoregion. In the next section, descriptions are provided for priority habitats associated with Species of Greatest Conservation Need found in this ecoregion.

- Westside Lowlands Conifer-Hardwood Forest
- Westside Oak and Dry Douglas-fir Forest and Woodlands
- Montane Mixed Conifer Forest
- Subalpine Parkland
- Alpine Grasslands and Shrublands
- Agriculture, Pasture and Mixed Environs
- Urban and Mixed Environs
- Open Water: Lakes, Rivers and Streams
- Herbaceous Wetlands
- Westside Riparian-Wetlands
- Montane Coniferous Wetlands
- Coastal Dunes and Beaches
- Coastal Headlands and Islets
- Bays and Estuaries
- Inland Marine Deeper Waters
- Marine Nearshore
- Marine Shelf
- Oceanic

# Pacific Northwest Coast Ecoregion

## Wildlife Habitat Classes

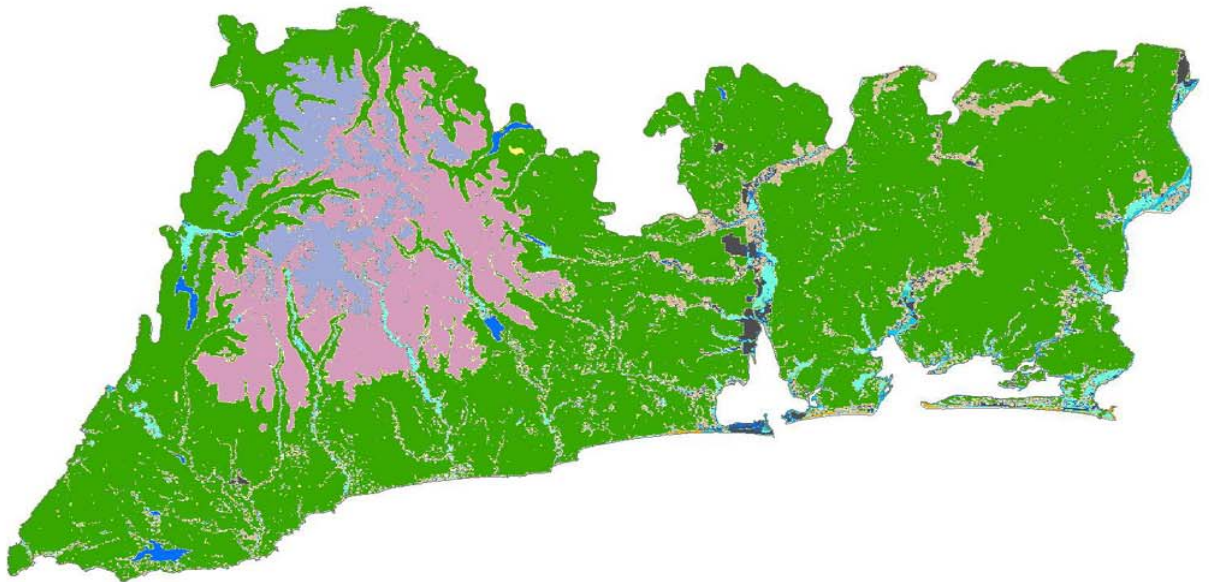
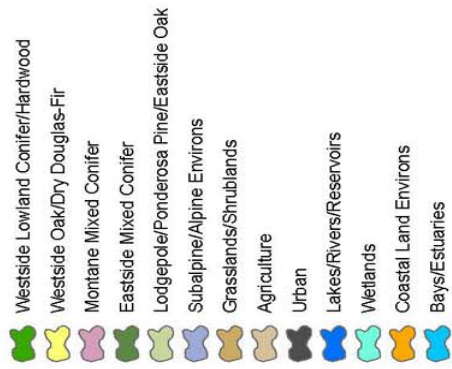


Figure 14.

### Priority Habitats in the Northwest Coast Ecoregion

The following six habitat types have been identified as the highest priority for current conservation action in the Northwest Coast ecoregion. Selection of these habitats as a priority was determined by their importance to regional Species of Greatest Conservation Need, as well as priorities outlined in the Northwest Coast Ecoregional Assessment and the subbasin plans listed in the "Major Plans" section above. More discussion on the selection of priority habitats is included in Chapter III: Statewide Overview and in Volume Two: Approach and Methods.

- Westside Lowlands Conifer-Hardwood Forest
- Westside Riparian-Wetlands
- Herbaceous Wetlands
- Coastal Dunes and Beaches
- Bays and Estuaries
- Marine Nearshore and Shelf

### **Westside Lowlands Conifer-Hardwood Forest**

The particularly cool and wet conditions along the Pacific coast form a naturally-occurring narrow band of forest dominated by Sitka spruce and lodgepole pine, which are tolerant of persistent salt spray. The most widespread forest type in the Northwest Coast ecoregion is Douglas-fir/hemlock. Other widespread tree species include western redcedar, grand fir and western white pine. Riparian forests along rivers and streams are often dominated by broadleaf hardwood species such as bigleaf maple, black cottonwood and red alder.

#### **Selected Species Closely Associated with Westside Lowlands Conifer-Hardwood Forest in the Northwest Coast Ecoregion**

Fisher	Keen's myotis
Marbled murrelet	Northern spotted owl
Western bluebird	Marten
Puget (Blackmore's) blue butterfly	
Crowned tightcoil (snail)	

### **Westside Riparian-Wetlands**

Westside riparian-wetlands habitat typically occupies patches or strips within a matrix of mature or young forests. It is most frequently associated with Westside lowlands conifer and hardwood forests, but is also found within agriculture, urban and coastal dunes and beaches habitats. In riparian areas associated with lowland forests, characteristic vegetation includes willows, alder, Oregon ash, black cottonwood, Pacific ninebark, Indian plum, vine maple, hazelnut, sedges and stinging nettle. Westside riparian-wetlands habitat also forms mosaics with or includes small patches of herbaceous wetlands, sphagnum bogs, forested woodlands and scrub-shrub wetlands. This habitat occurs not just along rivers, but at isolated sites as well.

## Herbaceous Wetlands

Herbaceous wetlands exist as integral components of larger landscape ecosystems and are found in association with most other habitats occurring in the Northwest Coast ecoregion. They commonly form a pattern with Westside riparian-wetlands habitats along stream corridors. Herbaceous wetlands include ponds, marshes and seasonally flooded meadows. Although many freshwater wetlands are associated with lakes, rivers and other shorelines, many more are isolated from surface water bodies and owe their existence to groundwater discharge through springs, seeps and precipitation. Fens are of particular concern; these systems are especially susceptible to disturbance, including blocked drainage and the resultant change in water level. Along the ecoregion's extensive coastal deflation plain (areas where the ground has subsided), wetlands have developed between coastal dunes and beaches habitat and the Pacific Ocean.

**Selected Species Closely Associated with  
Westside Riparian-Wetlands and/or Herbaceous Wetlands  
in the Northwest Coast Ecoregion**

Great blue heron	Van Dyke's salamander
Trumpeter swan	Western grebe
Western toad	Columbia torrent salamander
Fisher	Olympic mudminnow
Makah (Queen Charlotte) copper butterfly	
Dunn's salamander	

## Coastal Beaches and Dunes

**Dunes:** Much of the south Pacific coast is backed by dry, shifting sand dunes and ephemeral pools, subject to salty winds. Dune segments form spits or peninsulas at the mouth of Grays Harbor, Willapa Bay and the Columbia River. The dunes' shapes are controlled by sand supply, wind, water and stabilization by plants. Wind plays an important role in shifting the dunes. Foredunes, closest to the ocean, form an important defense against ocean storm damage and very high tides, and the troughs between the foredunes and the inner dunes hold groundwater reserves.

**Beaches:** Much of the western coast of the ecoregion in Washington, from Point Grenville to the mouth of the Columbia River, is composed of beaches that were historically nourished primarily by sediment from the Columbia River. The sand is constantly stirred by strong wave action, which results in a moveable substrate unsuitable for attachment by large plant species shoreward of the dunes. Beds of surf grass, a seed plant that flowers and pollinates itself underwater, grow in gravelly areas that are partially covered with sand. Where gravel dominates the substrate, rockweed is not uncommon. Eelgrass and surf grass beds thrive in pocket beaches. Further shoreward near the base of the dunes where wave action is minimal, beach silvertop and beach primrose can be found.

**Selected Species Closely Associated  
with Coastal Beaches and Dunes  
in the Northwest Coast Ecoregion**

Snowy plover	Streaked horned lark
Siuslaw sand tiger beetle	Oregon silverspot butterfly

## Bays and Estuaries

The three major estuaries of the Northwest Coast ecoregion are the shallow coastal embayments of Grays Harbor and Willapa Bay, and the Columbia River estuary. Their shorelines are characterized by small cities and towns, extensive farms and dairy lands, and shellfish aquaculture. Most shorelines are in private ownership with the exception of Willapa Bay and Grays Harbor, where portions lie within the Willapa and Grays Harbor National Wildlife Refuges.

Grays Harbor: the Wishkah, Chehalis, Elk, Humptulips and other rivers feed Grays Harbor, a shallow estuary encompassing 58,000 acres. It is an important nursery ground for juvenile salmon and passageway for returning adults. One of the most important staging areas for shorebirds along the west coast of North America, this estuary provides a critical refueling point for western sandpipers and other shorebirds migrating between their northern breeding grounds and winter grounds to the south. In 1988, approximately 1500 acres was designated as the Grays Harbor National Wildlife Refuge, which is managed by the U.S. Fish and Wildlife Service. In 1996, the Grays Harbor estuary was recognized as a Western Hemisphere Shorebird Reserve Network site of hemispheric importance.

Willapa Bay: Willapa Bay is the largest of Washington's estuaries and covers roughly 129 miles of shoreline. Rivers such as the North and the Willapa drain over 680,000 acres of Willapa Bay watershed. Approximately half of Willapa Bay as measured at high tide becomes exposed at low tide, thus creating around 47,000 acres of intertidal area. The twice-daily tidal change exposes large sand or mudflats adjacent to emergent salt marshes. These mudflats are typically empty of emergent vegetation, but support eelgrass and benthic invertebrates, which are essential food for higher-order organisms.

*November 18, 1805. Clark: I set out with 10 men and my man York to the Ocean by land. . . the waves appear to brake with tremendous force in every direction quite across. . . a large Sand bar lies within the mouth nearest to point Adams which is nearly covered at high tide. men appear much Satisfied with their trip beholding with astonishment the high waves dashing against the rocks & this emence Ocean.*

Columbia River Estuary: The Columbia River estuary is the largest in the Pacific Northwest at 147 square miles. Unlike other large estuaries in the ecoregion, the open ocean influence is considerable. Large vessels involved in world trade navigate through the estuary enroute to several ports upstream, the largest of which is Portland, Oregon. Only a moderate proportion of the total estuary is intertidal. The estuary is of key significance to waterfowl, anadromous fish and Columbia white-tailed deer, a federally-listed endangered species. Marsh habitats were once more extensive, but large areas have been diked and are now used for agricultural purposes.

**Selected Species Closely Associated  
with Bays and Estuaries  
in the Northwest Coast Ecoregion**

Brant	Common loon
Greater scaup	Great blue heron
Northern pintail	Marbled godwit
Surf scoter	Purple martin
Western grebe	Surfsmelt
Pacific sand lance	Lower Columbia steelhead
Red knot	Columbia white-tailed deer

### **Marine Nearshore and Shelf**

The outer coast of Washington is oriented in a roughly north-south direction for about 150 miles from Cape Flattery at the mouth of the Strait of Juan de Fuca to Cape Disappointment at the mouth of the Columbia River. The coast is flanked by a relatively shallow, flat submerged area of land under the Pacific Ocean called the continental shelf. This shelf extends offshore to a depth of approximately 600 feet (100 fathoms). Although the earth's coastal shelf waters comprise only about seven percent of the total ocean area, they support more than 90 percent of the fisheries because of the high concentration of plankton that feed fish larvae and their prey. The sea floor, which in large part determines the plant and animal life common to the area, can be soft-bottomed or rocky.

*Coastal waters:* Giant kelp beds float along open coasts in waters about 15 to 90 feet deep. These large brown seaweeds are so thick and well anchored to the sandy bottom that they significantly moderate wave action, helping to protect beaches from erosion. Bull kelp has long hollow stems ending in inflated gas bladders that keep it floating at the water's surface. Dense canopies of kelp provide habitat to coastal animals including the giant kelpfish, striped sea perch, and a small but expanding population of sea otters. Northern sea otters were native to the outer coast of Washington but were eliminated by hunting for the fur trade before 1910. Reintroduced from Alaska, the recovering population is listed as endangered in Washington State.

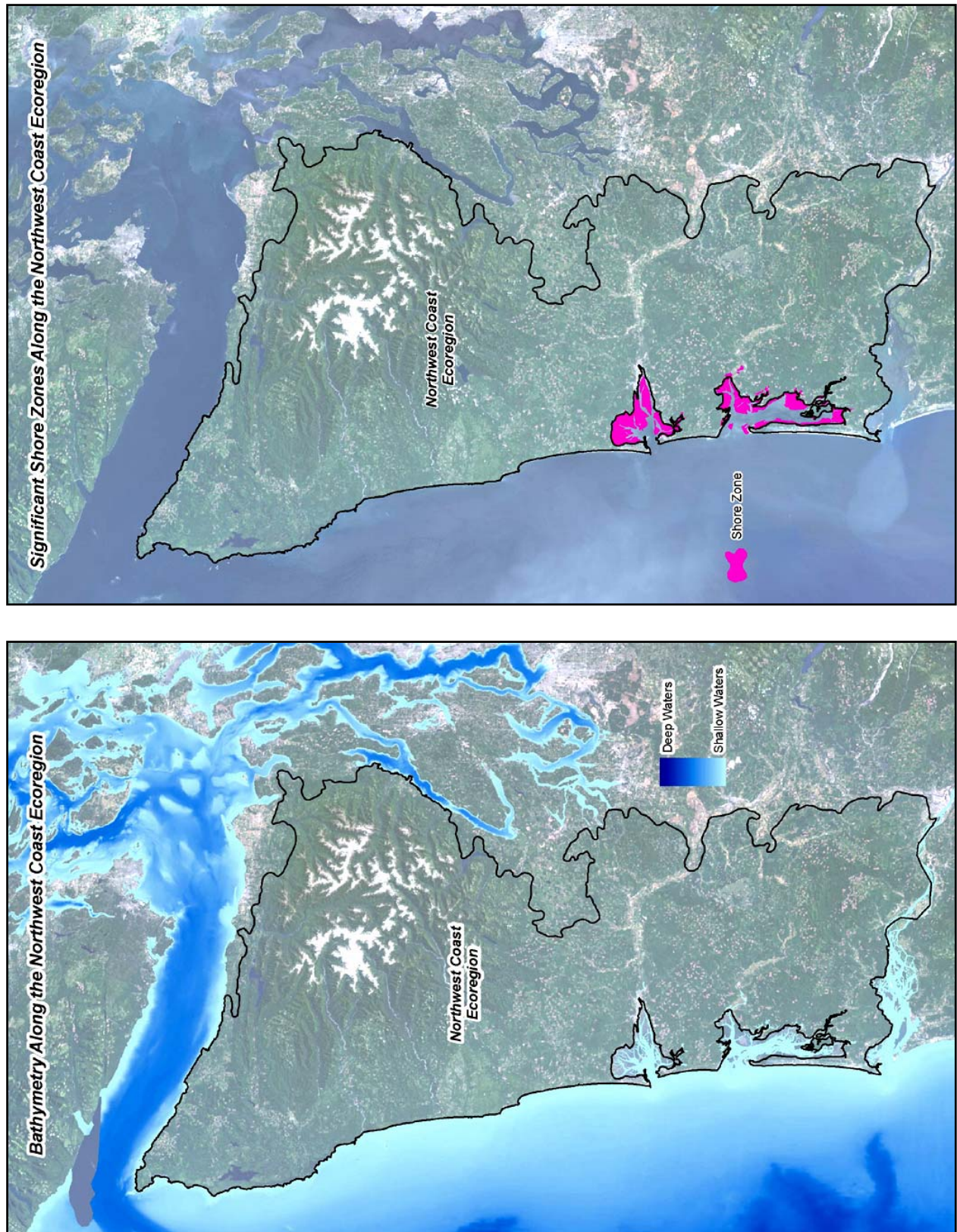
*Rocky intertidal:* Rocky substrate, moderate to strong wave and surf exposure, and a visible, vertical zonation pattern characterize rocky intertidal habitat. Diverse communities of invertebrates and algae grow in distinct horizontal bands dominated by rockweed, mussels or barnacles. Other common species include chitons, sea urchins, grazing snails, sea stars, hermit crabs and sea anemones, as well as worms and sea cucumbers that hide in crevices and under rocks. There are sheltered rocky shores that consist of vertical rock walls, bedrock outcrops, wide rock platforms and boulder-strewn ledges. These are usually found along sheltered bays or along the inside of bays and coves. Gravel, cobble and boulder beaches are usually narrow and steep. Kelps grow in abundance during the spring and summer; their biomass supports not only the rocky intertidal habitat, but soft-bottom habitats as well. See Figure 15 for a map depicting marine features of the Northwest Coast ecoregion.

**Selected Species Closely Associated with  
Marine Nearshore and Shelf Habitats  
in the Northwest Coast Ecoregion**

Common loon	Common murre
Rock sandpiper	Marbled murrelet
Steller sea lion	Sea otter
Surf scoter	Western grebe
Cassin's auklet	Killer whale
Pacific harbor porpoise	Tufted puffin
Copper rockfish	Black oystercatcher



Figure 15. Marine features of the Northwest Coast ecoregion.





## CONSERVATION PROBLEMS

Clearcut logging, road building and the fragmentation and conversion of natural habitats by commercial plantation forests, agriculture and expanding urban and residential development have seriously impacted this ecoregion, especially over the last 50 years.

### Logging and Associated Road Building

Logging and associated road building on both private and public forest lands was intensive for many years, until the federal ESA listing of the northern spotted owl in 1990 and subsequent adoption of the Northwest Forest Plan. Even though logging on the Olympic Peninsula and Willapa Hills has slowed in recent years, especially on public land, it remains the most significant potential long-term impact on wildlife and habitat in the Northwest Coast ecoregion.

Timber harvest changes upland and riparian vegetative cover and influences snow accumulation and melt rates. It may also contribute to fragmentation of habitat, soil erosion, sediment delivery to creeks and streams, and channel simplification from loss of large woody debris recruitment within the riparian zone. Native plant communities may be replaced by alien species following timber harvest. Road building associated with timber harvest may further exacerbate erosion and sedimentation, habitat fragmentation, and creates barriers to fish passage if culverts are impassable.

The future condition and value of the ecoregion's terrestrial and aquatic habitats will depend to a large degree on how intensively they are managed for timber and other uses in the future. The Northwest Forest Plan brought major improvements in streamside protections on federal lands. The recent State Forest and Fish Agreement has improved the outlook for this habitat type on private lands. However, riparian habitats that were altered and degraded in the past due to logging and road building need restoration.

### Invasive Alien Plants and Animals

Invasive alien plants and animals are a significant threat to biodiversity, second only to habitat loss. They are introduced in a number of ways, including hitchhiking on horses, boats, cars, trucks and ships, travel on ocean currents, being imported in aquaculture and horticultural products and the pet/aquarium trade, through ballast water from large ships, and accidental releases from research institutions and laboratories. Invasive plants displace native vegetation, resulting in the loss of habitat diversity and function. They can severely impact native plant and animal communities and alien grasses and shrubs can add significantly to the fire fuel load, resulting in hotter wildfires that increase damage to native vegetation. The number and abundance of introduced species in an ecoregion is an indicator of declining ecosystem health. A number of nuisance species are especially problematic in the Northwest Coast ecoregion.

### Habitat Loss and Modification

Marine, estuarine and tidally influenced freshwater rivers and streams are associated with the Pacific Ocean, Grays Harbor and Willapa Bay. These highly productive ecosystems have been most impacted by human activity: over 80 percent of the state's estuaries have been lost. Of those remaining, all have been degraded to some degree. Although population growth in the Northwest Coast ecoregion is much less than in the Puget Trough ecoregion, human activity over the last 100 years has significantly altered coastal estuaries and has resulted in significant habitat loss or modification. An estimated 40 percent of the original

Columbia River estuary has also been converted to dry land by diking and filling. Overall, development since the mid-19<sup>th</sup> century has resulted in a loss of 77 percent of the tidal swamps, 62 percent of the tidal marshes and 7 percent of the tidal flats in the Columbia River estuary. Dams, dikes, dredging, and agricultural and forest practices have also contributed to this loss and alteration of habitat.

Beaches, and especially dunes, are fragile, unstable and dynamic environments. Bulkheads, roads and other types of construction, if not properly designed and constructed, reduce the supply of sediments as well as the wind and wave action that form and help maintain beach and dune structure.

### Habitat Fragmentation

Wildlife species depend on corridors within and between wetlands, riparian areas and uplands for critical habitat. If the habitat becomes fragmented due to logging or development, the survival of certain species may be jeopardized. High-quality regionally rare wetlands such as peatlands and forested wetlands are especially sensitive to disturbance and take a very long time to regenerate.

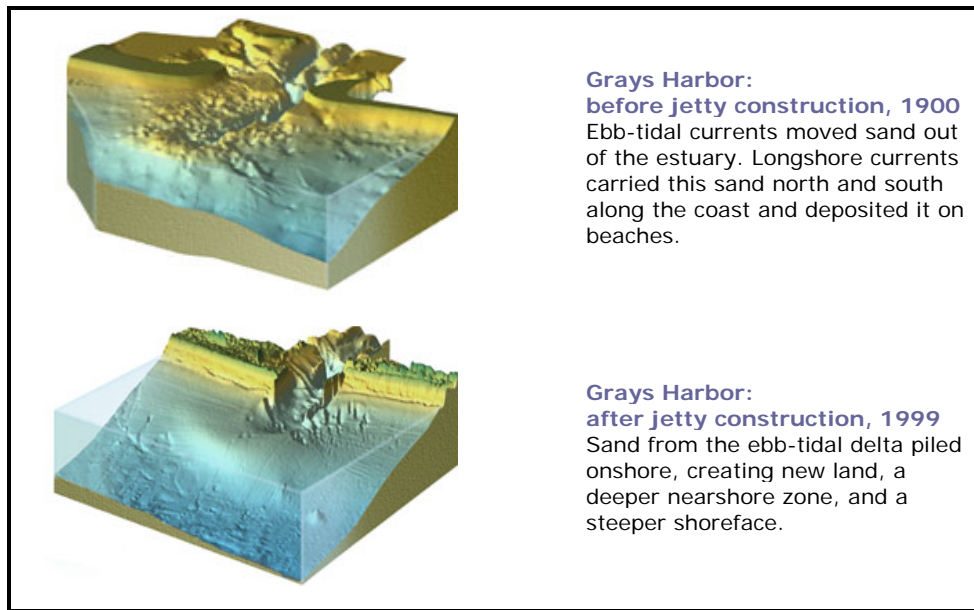
### Urban Development

Urban areas in this ecoregion are largely concentrated near estuaries and bays. Although the Northwest Coast is not growing as fast as some other regions of the state, urbanization has significantly impacted the natural system in some areas, especially Grays Harbor, and residential and commercial development is expanding in all coastal areas. Population growth and residential development is anticipated to continue at significant rates and the impacts of development practices and growth will result in irreversible loss of fish and wildlife habitat, especially estuarine and freshwater ecological processes. Low to medium density development along the ocean front is expanding, especially in coastal communities such as Westport, Ocean shores and Long Beach. This development is altering natural beach and dune-building processes.

### Shoreline Armoring

Shoreline armoring is increasing with residential and commercial development and can increase erosion by interfering with natural wave action. Bulkheads and other structures force waves to wash away the sand and small pebbles in front of them and the result is often a rocky beach lacking the fine sediment required for survival by many beach-dwelling plants and animals. See Figure 16 for an example of shoreline armoring effects.

Figure 16.



### Environmental Contaminants

Estuaries are especially vulnerable to nonpoint source pollution from water-based or land use activities, surface water runoff from agricultural lands, urban areas and forest lands; subsurface or underground sources; and discharges from boats or other marine vessels. Although degradation from any single activity or site usually will not violate water quality standards, the cumulative effects of all the activities in a watershed can result in significant water quality problems. The sources of pollution include untreated stormwater (particularly with heavy metals), septic leachate, sediment, nutrient and pesticide (weed and feed) fluxes, toxins, garbage, off-road vehicles and groundwater pumping. Impairment of water quality or quantity will particularly affect plant species diversity and amphibian and bird populations. Offshore oil spills have occurred in recent years, and as petroleum shipping activity increases, it poses an increasing threat to marine and shore-dwelling wildlife species.

### Increasing Recreational Demand

As the Northwest Coast ecoregion's population increases, so does the demand for water-related opportunities, especially on public land and beaches. Increasing public demand results in shoreline development of buildings, jetties and moorage facilities, all of which may destroy habitat and cause both point and nonpoint pollution.

The following additional habitat and species conservation problems have been identified in the Northwest Coast Ecoregion:

Wildlife species and population problems: includes disease, pathogens, competition, food scarcity, predation, overharvest, and limited population size and distribution.

- Populations of killer whale, Steller sea lion, sea otter, Columbian white-tailed deer, common loon, bald eagle, peregrine falcon, snowy plover, marbled murrelet, northern spotted owl, pygmy whitefish, Olympic mudminnow and Oregon silverspot have declined to the point that they are listed as endangered, threatened or state sensitive. Populations of gray wolf and fisher have become extirpated.
- Small population sizes and loss of genetic diversity are problems in Olympic marmot, southern resident killer whale, sea otter, marten, Columbian white-tailed deer, Van Dyke's salamander and Columbia torrent salamander, and are a concern in other species reduced to isolated populations, including Keen's myotis, pygmy whitefish, Olympic mudminnow, western floater, winged floater, Oregon floater, western ridged mussel, western pearlshell and Oregon megomphix.
- Competition for food exists between Columbian white-tailed deer and elk.
- Visitor feeding of coyotes may increase predation on Olympic marmot.
- Predation by gulls, eagles, and other avian and mammalian predators at breeding colonies can negatively impact common murre and Cassin's auklet.
- Predation by sea lions, seals, lingcod, and other piscivorous fish contribute significant amounts of mortality to copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish and yelloweye rockfish.
- Historic declines in salmon and possibly other fish likely reduce prey availability for southern resident killer whale.
- Commercial fisheries harvest may reduce important prey for Steller sea lion and common murre.
- Incidental mortality from gill nets, salmon trolls and other fishery gear affects Pacific harbor porpoise, Steller sea lion, sea otter, western grebe, common murre, marbled murrelet, ancient murrelet and Cassin's auklet.
- Illegal take occurs for bald eagle and migrating and spawning fish species of concern.
- Northern pintail, greater scaup, lesser scaup, long-tailed duck, scoters (black, surf, white-winged) and bull trout are susceptible to overharvest.
- Overharvest, as bycatch by both commercial and recreational fishermen, is an important source of mortality in copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, yelloweye rockfish, green sturgeon and bull trout.
- Historic declines of native fish populations limit the availability of hosts for parasitic larval stages of western floater, winged floater and Oregon floater.

Lack of biological information on species and habitats:

- Adequate information is lacking on the population status of state candidate species, including Keen's myotis, Townsend's big-eared bat, Mazama pocket gopher, Pacific harbor porpoise, western grebe, tule greater white-fronted goose, northern goshawk, golden eagle, common murre, Cassin's auklet, tufted puffin, Vaux's swift, pileated woodpecker, purple martin, Dunn's salamander, Van Dyke's salamander, Columbia torrent salamander, western toad, river lamprey, copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, yelloweye rockfish, eulachon, Makah (Queen Charlotte) copper, Johnson's hairstreak, and valley silverspot.

- Additional distributional data are needed for Dunn's salamander, Van Dyke's salamander, western toad, green sturgeon, bull trout, Siuslaw sand tiger beetle, Makah (Queen Charlotte) copper, Johnson's hairstreak, Puget Sound fritillary, valley silverspot, western floater, winged floater, Oregon floater, western ridged mussel, western pearlshell, and Oregon megomphix.
- There is a lack of information on whether marten and crowned tightcoil continue to exist in the ecoregion.
- Data are needed on limiting factors, habitat associations, demography, or food habits for many species, including Keen's myotis, Mazama pocket gopher, southern resident killer whale, fisher, marbled murrelet, pileated woodpecker, Dunn's salamander, Van Dyke's salamander, Columbia torrent salamander, river lamprey, Pacific lamprey, copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, yelloweye rockfish, eulachon, Siuslaw sand tiger beetle, Puget Sound fritillary, western floater, winged floater, Oregon floater, western ridged mussel, western pearlshell, crowned tightcoil, and Oregon megomphix.
- Information is needed on the causes of decline for western toad, river lamprey, and Pacific lamprey.
- Standard survey protocols are needed to determine the abundance and trends of great blue heron and marbled murrelet.
- The effects of plastic pollution and ingestion at sea need investigation in tufted puffins.
- Information on the impacts of land use practices and forest practices is lacking for Columbia torrent salamander.
- Better data are needed on the amount of gene flow among bull trout populations.
- The impacts of river dredging on spawning habitat and the survival of incubating eggs and larvae needs study in eulachon.
- Annual quantitative stock assessments of eulachon are needed to estimate desirable harvest rates.
- Adequate harvest statistics are generally lacking for sport and commercial surfsmelt fisheries.
- Taxonomic relationships need investigation in western toad, western floater, winged floater, Oregon floater, western ridged mussel, western pearlshell, and crowned tightcoil.
- There is a shortage of adequate spatial inventory and assessment data on most habitat types.
- There is an absence of baseline data on the habitat values and functions of natural wetlands and a poor understanding of the status of resident macroinvertebrates in aquatic systems.

#### Habitat loss, conversion, fragmentation and degradation:

- Only 3% of western Washington forest is currently in the old growth age class and nearly all of it is in high elevation national forests or national parks. Maintenance of old growth forest across the landscape is important for at least 1,000 species. Loss and fragmentation of late-successional coniferous forests negatively impacts fisher, northern goshawk, marbled murrelet, northern spotted owl, pileated woodpecker, and Johnson's hairstreak butterfly.
- Grassy and herbaceous balds are rare patch habitats distributed in low and high elevation forests. They often have associated rare species that are vulnerable to certain forest practices and recreation.
- Suburban sprawl is a concern for resource managers as indicated by the growing number of ranchettes and residential subdivisions in previous managed forest and

cropland. Development often occurs near lakes or streams and poses an increased threat of fire and impacts to water quality.

- Shoreline timber harvest and development may destroy nesting, foraging, or roosting sites for common loon, great blue heron, and bald eagle.
- Human development and logging negatively impacts forest habitat for northern goshawk and Oregon megomphix.
- Forest clearing may destroy habitat for Van Dyke's salamander and may degrade habitat for Townsend's big-eared bat.
- Reclamation of abandoned mines may destroy critical maternity roosts and hibernacula for Townsend's big-eared bat.
- Flooding of riverine areas temporarily damages the habitat of Columbian white-tailed deer.
- Drainage and degradation of wetlands and development of agricultural lands have reduced winter habitat and food abundance for trumpeter swan, tule greater white-fronted goose, northern pintail, and lesser scaup.
- Wetland conversion and drainage may destroy habitat for Olympic mudminnow.
- Conversion of coastal bogs negatively impacts Makah (Queen Charlotte) copper.
- Urbanization and industrialization of coastal shorelines, bays and estuaries have degraded some winter habitat and reduced food abundance for long-tailed duck and scoters.
- Declines of eelgrass reduce foraging habitat for brant.
- Loss of or damage to spawning beaches caused by armoring, deforestation, erosion, or oiling of shorelines affects populations of surfsmelt and Pacific sand lance.
- Degradation of streams and rivers due to inappropriate forest management and agricultural practices and human development is harmful to bull trout.
- Future modifications to the Tokeland marina could eliminate the only important roost site for willet and marbled godwit in the ecoregion.
- Insufficient nesting sites limit population growth of purple martin and western bluebird.
- Commercial and residential development reduces and degrades open forest and edge habitats used by western bluebirds.
- Degradation of open areas with lupine negatively impacts Puget (Blackmore's) blue butterfly.
- Coastal dune stabilization has altered the plant communities used by Oregon silverspot.
- Degradation of native grasslands and forest balds damages the habitat of valley silverspot.
- The small number of haul-out sites forces Steller sea lion to concentrate at a few important locations.

#### Incompatible land management practices:

- Various timber cutting, snag removal, and replanting practices have degraded or eliminated habitat for a variety of species, including Keen's myotis, bald eagle, marbled murrelet, northern spotted owl, Vaux's swift, pileated woodpecker, and western bluebird.
- Forestry practices that result in the removal of forest overstory above talus, loss of large woody debris, and alteration of streams destroy habitat for Dunn's salamander and Van Dyke's salamander.
- Forestry practices that reduce the occurrence of mistletoe likely affect Johnson's hairstreak.
- Logging activities that elevate stream temperature, alter hydrology, and increase stream sedimentation eliminate aquatic habitat for Columbia torrent salamander.

- The spraying of forests with Btk to kill tussock moths and budworms has caused population losses in Johnson's hairstreak butterfly.
- Forestry practices that cause declining moisture conditions on forest floors and a loss of coarse woody debris in stands of bigleaf maple and mixed hardwood-conifer stands reduce habitat for Oregon megomphix and other invertebrates.
- Modern agricultural practices often reduce the quality, patch size and connectivity of wildlife habitat in farmlands.

#### Alien and invasive plant and animal species:

- Encroachment of non-native species such as reed canary grass, purple loosestrife, domestic pets, bullfrogs and rats is a threat to the ecology of native wetland and riparian ecosystems.
- Saltmeadow cordgrass (*Spartina patens*) generally occupies the upper salt marsh zone, but also colonizes sand dunes. It is an aggressive noxious weed that severely disrupts the ecosystems of native shoreline habitats. European beachgrass (*Ammophila arenaria*) is an invasive, introduced grass brought in for dune stabilization. It poses the biggest threat for dune habitat, impacting western snowy plover and streaked horned lark nesting areas.
- A large portion of Willapa Bay's mudflats have been invaded and drastically altered by the introduced cordgrass *Spartina alterniflora*, which aggressively colonizes mudflats and salt marshes, displacing native plant and animal species and altering the ecological landscape by transforming mudflats into salt marshes. As of 2003, 32% (15,040) acres of the intertidal area of Willapa Bay was infested with *Spartina*.
- Reed canary grass thrives in reservoirs and wetland stream outlets where water levels fluctuate and directly affects habitats that support 27 Washington state-listed plant species. A number of native fish, amphibians and other animals are not well adapted to spawn or reproduce in reed canary grass thickets.
- Species such as the European green crab, the Asiatic clam and the Japanese oyster drill pose threats to both native wildlife species and the shellfish industry.
- There is considerable evidence of competition for nesting territories between northern spotted owl and expanding populations of barred owl.
- Non-native European starlings and house sparrows compete extensively for nest cavities in snags and birdhouses with purple martins and western bluebirds.
- Dense growth of European beachgrass reduces habitat for snowy plover, streaked horned lark, and Siu law sand tiger beetle.
- Habitat changes caused by the invasion of non-native plants have negatively affected dog star skipper, Puget (Blackmore's) blue butterfly, Puget Sound fritillary, Oregon silverspot, and valley silverspot.
- The spread of *Spartina* spp. threatens the quality of foraging habitat for red knots visiting Willapa Bay.
- Predation by introduced fish negatively impacts pygmy whitefish and Olympic mudminnow.
- Non-native fish such as brook trout pose a threat to bull trout through competition, hybridization and predation.
- Competition from introduced clams such as the Asian clam and other aquatic invaders affects western floater, winged floater, and Oregon floater.

#### Human disturbance and recreational impacts:

- Human disturbance can disrupt the maternity roosts and hibernacula of Pacific Townsend's big-eared bat, breeding colonies of great blue heron, common murre, Cassin's auklet, and colonies of Olympic marmot.
- Shoreline development, recreational boating and fishing and other forms of human presence may disturb or displace nesting or foraging birds, including common loon, great blue heron, brant, greater scaup, bald eagle, black oystercatcher.
- Vessel disturbance and noise disturbs killer whales and Pacific harbor porpoise
- Nesting peregrine falcons are vulnerable to disturbance from human activities, such as blasting and timber cutting.
- Backcountry recreation such as motorized vehicles and hiking may disturb or displace golden eagle and peregrine falcon.
- Mortality of lesser scaup from fishing nets and lines may be substantial.
- Beach walkers, pets, and cars may disturb snowy plover and streaked horned lark and destroy their nests.
- Cars compact beach soils, thereby reducing prey availability for snowy plover.
- Trampling and crushing by people and vehicles may cause mortality in Siuslaw sand tiger beetle along coastal beaches.
- Recreational activities such as offroad recreational vehicles, horses, mountain bikes, and even hikers can create unauthorized trails that disturb soil and allow invasive plants to establish.

#### Environmental contaminants:

- Ingestion of lead fishing sinkers by common loon and lead shot by trumpeter swan, bald eagle, and golden eagle results in lead poisoning.
- High concentrations of environmental contaminants such as PCBs, PBDEs, dioxins, furans, and heavy metals) have been found in killer whale and Pacific harbor porpoise.
- Ship-related oil spills pose a significant risk to killer whale, Pacific harbor porpoise, Steller sea lion, sea otter, commons loon, western grebe, brant, long-tailed duck, snowy plover, black oystercatcher, willet, marbled godwit, red knot, rock sandpiper, arctic tern, common murre, marbled murrelet, ancient murrelet, Cassin's auklet, tufted puffin, and streaked horned lark.
- Chemical and heavy metal contamination of winter food supplies may affect the reproductive success or survival of tule greater white-fronted goose, brant, greater scaup, long-tailed duck, and scoters (black, surf, white-winged).
- Accumulation of persistent organic pollutants, endocrine disrupting chemicals, and heavy metals may disrupt the growth and reproduction of copper rockfish and quillback rockfish.
- Aquatic pollution is harmful to green sturgeon, western floater, winged floater, Oregon floater, western ridged mussel, and western pearlshell.
- Piscicides such as rotenone that are used for eliminating undesirable fish species from lakes and streams also kill pygmy whitefish.
- Roadside herbicide spraying can damage the habitat of dog star skipper.
- Toxic contaminants have been found in sediment and fish tissue. Levels of PCBs, DDE and dioxin are high enough in the ecoregion that they may be linked to reproductive failure in bald eagle, mink and river otters.



Incompatible transportation and energy development:

- Roads placed near great blue heron rookeries may result in site abandonment.
- Roads located near breeding sites may cause highway mortality in western toad.
- Highway mortality affects Columbian white-tailed deer.
- Road building may isolate populations of Dunn's salamander and Van Dyke's salamander.
- Golden eagle and other raptors can be electrocuted on power lines.

Inadequate water quantity and quality:

- Increased sedimentation, increased water temperature, and reduced water quality caused by logging, road construction, improperly managed grazing, and overdevelopment negatively impacts Columbia torrent salamander, green sturgeon, pygmy whitefish, western floater, winged floater, Oregon floater, western ridged mussel, and western pearlshell.
- Dams and other passage barriers limit the movement of river lamprey, Pacific lamprey, green sturgeon, and bull trout.
- Fluctuating water levels and dam presence can degrade or eliminate habitat for western floater, winged floater, and Oregon floater.



## CONSERVATION ACTIONS

Conserve and recover wildlife species and populations: includes population management, protect known populations, augment and reintroduce populations, control and monitor mortality and enhance food/prey.

- Implement recovery actions for the Steller sea lion, fisher, sea otter, Columbian white-tailed deer, northern spotted owl, snowy plover, marbled murrelet, bull trout, and Oregon silverspot butterfly.
- Survey potential nesting habitat prior to timber harvest and follow existing federal and state statutes regarding occupancy to protect the marbled murrelet and spotted owl.
- Implement the Northwest Forest Plan for managing northern spotted owl habitat.
- Prepare or complete recovery plan for the southern resident killer whale, northern spotted owl, and bull trout.
- Complete the Washington Bat Conservation Plan.
- Develop management plans for state sensitive species, including common loon, peregrine falcon, pygmy whitefish, and Olympic mudminnow.
- Develop management recommendations for dog star skipper.
- Continue transplanting Columbian white-tailed deer to appropriate sites along the Columbia River to increase numbers and distribution.
- Reintroduce fisher into areas of suitable habitat on the Olympic peninsula and Oregon silverspot butterflies to coastal sites on the Long Beach Peninsula, as called for in recovery plans and feasibility studies.
- Investigate opportunities for translocating or reintroducing Mazama pocket gopher, marten, winged floater, Oregon floater, western ridged mussel, western pearlshell, crowned tightcoil, and Oregon megomphix.
- Implement salmon recovery strategies to enhance the prey base for southern resident killer whale and bald eagle.
- Establish and implement fisheries management objectives that are compatible with bull trout recovery.
- Use special hunts and fencing to minimize competition between Columbian white-tailed deer and elk at Julia Butler Hansen National Wildlife Refuge and other sites along the Columbia River.
- Continue limited coyote control to reduce predation on Columbian white-tailed deer fawns.
- Conduct predator control programs at nesting colonies of common murre and Cassin's auklet, as necessary.
- Maintain conservative hunting regulations for northern pintail, greater scaup, lesser scaup, long-tailed duck, and scoters (black, surf, white-winged).
- Implement and enforce restricted harvest regulations for green sturgeon.
- Develop and implement a management plan to control the harvest of eulachon.
- Reduce opportunities for harvest and restrict retention by fishermen to protect copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, and yelloweye rockfish.
- Monitor harvest levels of surfsmelt.
- Manage fisheries harvests to reduce competitive impacts on southern resident killer whale, Steller sea lion, common murre, marbled murrelet, ancient murrelet, Cassin's auklet, and tufted puffin.
- Install single-cavity birdhouses and gourds to enhance populations of purple martin.
- Provide nest boxes to western bluebirds as a short-term solution to limited cavity availability.

- Establish marine protected areas or other types of area-gear restrictions to restore populations of copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, and yelloweye rockfish.
- Identify and protect sites for Olympic mudminnow, dog star skipper, **valley silverspot**, crowned tightcoil, and Oregon megomphix.



Conduct research, assessment and monitoring: includes species and habitat distribution, abundance, limiting factors, suitable habitat and population trends.

- Determine the status of candidate species, including Townsend's big-eared bat, Keen's myotis, Mazama pocket gopher, Pacific harbor porpoise, western grebe, northern goshawk, golden eagle, common murre, Cassin's auklet, tufted puffin, Vaux's swift, pileated woodpecker, purple martin, Dunn's salamander, Van Dyke's salamander, Columbia torrent salamander, western toad, river lamprey, copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, yelloweye rockfish, eulachon, Makah (Queen Charlotte) copper, Johnson's hairstreak, and valley silverspot.
- Monitor population trends of Steller sea lion, fisher, sea otter, Columbian white-tailed deer, northern spotted owl, snowy plover, marbled murrelet, bull trout and Oregon silverspot butterfly to determine whether recovery objectives are being met.
- Monitor post-downlisted populations of peregrine and bald eagle for signs of decline that could result from bio-accumulation of contaminants or other factors.
- Monitor populations of rockfish (copper, quillback, China, tiger, bocaccio, canary, redstriped, yelloweye) using multiple methods, including ones not dependent on harvest.
- Seek reports of sightings of southern resident killer whales along the outer coast and of martens on the Olympic Peninsula.
- Gather further distribution data on Keen's myotis, Townsend's big-eared bat, Mazama pocket gopher, southern resident killer whale, Dunn's salamander, Van Dyke's salamander, western toad, river lamprey, Pacific lamprey, copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, yelloweye rockfish, bull trout, green sturgeon, Olympic mudminnow, surfsmelt, Pacific sand lance, Siuslaw sand tiger beetle, Makah (Queen Charlotte) copper, Johnson's hairstreak, Puget Sound fritillary, western floater, winged floater, Oregon floater, western ridged mussel, western pearlshell, crowned tightcoil and Oregon megomphix.
- Identify important nearshore foraging areas along the coast for marbled murrelet.
- Identify roost sites and hibernacula of Townsend's big-eared bat.
- Conduct habitat selection studies at multiple spatial scales for Keen's myotis, marbled murrelet, Vaux's swift, river lamprey, Pacific lamprey, green sturgeon, eulachon, western floater, crowned tightcoil, and Oregon megomphix.
- Continue to investigate the levels and effects of contaminants on killer whales and Pacific harbor porpoise.
- Investigate the foraging ecology of Steller sea lion and the available prey base.
- Monitor predator (e.g. seals, sea lions and piscivorous fish) population trends and food habits, especially in areas of rockfish recovery, copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, and yelloweye rockfish.

- Monitor populations of prey eaten by long-tailed ducks and scoters (black, surf, white-winged).
- Determine the causes of wintering population declines in western grebes and scoters (black, surf, white-winged).
- Investigate the conservation needs of Columbia torrent salamander.
- Identify the limiting factors in populations of river lamprey and Pacific lamprey.
- Determine the extent of mortality from gillnet fisheries in Pacific harbor porpoise, Steller sea lion, sea otter, western grebe, common murre, marbled murrelet, ancient murrelet, and Cassin's auklet.
- Improve identification methods to distinguish between river lamprey and Pacific lamprey.
- Identify all spawning beaches for surfsmelt and Pacific sand lance so they receive regulatory protection.
- Develop survey protocols to monitor the abundance of great blue heron, copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, eulachon, and Pacific sand lance.
- Develop methods to track and measure reproductive contribution of localized populations of copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, and yelloweye rockfish.
- Evaluate whether existing forest management prescriptions are adequate to maintain populations of pileated woodpeckers.
- Develop habitat management recommendations for Oregon megomphix.
- Determine the amount of genetic diversity and gene flow among bull trout populations.
- Investigate the taxonomy of western toad, western floater, winged floater, Oregon floater, western ridged mussel, western pearlshell, and crowned tightcoil using genetic techniques and other analyses.
- Determine abundance, status, trend, distribution, and limiting factors of candidate species, including, Pacific Townsend's big-eared bat, Keen's myotis, Mazama pocket gopher, killer whale, Pacific harbor porpoise, sea otter, Steller sea lion, marten, Columbian white-tailed deer, great blue heron, tule greater white-fronted goose, northern goshawk, marbled murrelet, Vaux's swift, western bluebird, western toad, Dunn's salamander, Van Dyke's salamander, Columbia torrent salamander, river lamprey, Pacific lamprey, copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, bocaccio rockfish, canary rockfish, redstriped rockfish, yelloweye rockfish, green sturgeon, pygmy whitefish, eulachon, Olympic mudminnow, surfsmelt, Pacific sand lance, Siuslaw sand tiger beetle, dog star skipper, Makah (Queen Charlotte) copper, Johnson's hairstreak, Puget Sound fritillary, valley silverspot, western floater, winged floater, Oregon floater, western ridged mussel, western pearlshell, crowned tightcoil, Oregon megomphix.
- Research life history, population dynamics, limiting factors, dispersal, and impacts of forest practices and development and habitat needs at various scales as needed for Keen's myotis, tufted puffin, Vaux's swift, pileated woodpecker, Dunn's salamander, Van Dyke's salamander, Columbia torrent salamander, western toad, river lamprey, Pacific lamprey, copper rockfish, greenstriped rockfish, quillback rockfish, China rockfish, tiger rockfish, **bocaccio rockfish**, canary rockfish, redstriped rockfish, yelloweye rockfish, green sturgeon, eulachon, Siuslaw sand tiger beetle, western floater, winged floater, Oregon floater, western ridged mussel,



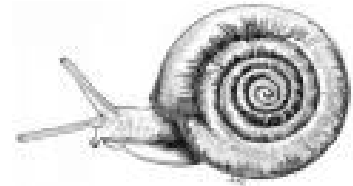
- western pearlshell, crowned tightcoil, Oregon megomphix.
- Assess and map important habitats and areas of high biodiversity in the ecoregion using ecoregional assessments, local habitat assessments, Interagency Vegetation Mapping Project, and other habitat inventories and plans. Update ecoregional assessments every five years.
- Develop statewide land cover and threats data layers to improve connectivity between priority conservation areas.
- Identify and assess key connectivity areas and wildlife corridors between fragmented habitats and between protected areas. Restore habitat connectivity and wildlife corridors where appropriate on both public and private lands.
- Improve understanding of the ecological processes of seeps, bogs, wet meadows, forested wetlands, marshes, springs and other wetlands, and how they are impacted by human development.
- Conduct hydrologic studies that include water quantity and chemical budgets at wetlands known to be supporting rare and endangered species. Use this information to inform wetland management.
- Inventory and prioritize riparian habitat types and attributes needing protection and conservation.
- Identify important habitats for restoration and assess the feasibility of successfully restoring these sites. Include an evaluation of current and projected land use in and adjacent to potential restoration sites.
- Coordinate the collection and analysis of data on alien species, shoreline modifications, trends in kelp beds and other indicators of ecosystem health in Puget Sound.
- Develop a cohesive, priority-driven research program for westside grassland habitats that integrates university, agency and private researchers. Inventory important grassy and herbaceous balds. Work with land management agencies and private land owners to protect these habitats from disturbance and development.

Protect, restore and connect habitats:

- Maintain mature and late-successional coniferous forests from harvest to protect fisher, northern goshawk, marbled murrelet, northern spotted owl, Vaux's swift, and Johnson's hairstreak butterfly.
- Establish new protected areas where ecological gaps remain in the existing protected areas system on public land, especially in natural-origin forests in the Willapa Hills and on the Olympic Peninsula coastal plain.
- Manage timber harvest and fire management activities on state, private, and federal lands to perpetuate adequate amounts of habitat for the marbled murrelet and northern spotted owl.
- Protect rare habitat types such as grassy and herbaceous balds, snag patches, caves, cliffs, rocky outcrops, and talus.
- Continue to restore woodland, grassland, and wetland habitats along the Columbia River for Columbian white-tailed deer.
- Manage marine bays and estuaries to the reduce impacts of urbanization and industrialization, thereby protecting habitats used by brant, greater scaup, lesser scaup, long-tailed duck, scoters (black, surf, white-winged), and marbled murrelet.
- Protect eelgrass beds for brant by managing shoreline development and other human activities.
- Protect land near large great blue heron colonies and known marbled murrelet nesting areas through acquisitions, conservation easements and agreements, and management plans.



- Protect wetlands and agricultural lands from development through acquisitions, easements, conservation agreements, and management plans, thereby benefiting trumpeter swan, tule white-fronted goose, northern pintail, and lesser scaup.
- Protect and restore riparian areas for bull trout.
- Limit vehicle traffic along beaches used by snowy plover and streaked horned lark.
- Determine if protection of other beach species such as snowy plover and streaked horned lark adequately addresses the needs of Siuslaw sand tiger beetle.
- Protect nesting areas for streaked horned lark on dredge spoil islands in the lower Columbia River and manage spoil deposition to maintain and increase open habitat.
- Restore coastal grasslands on the Long Beach Peninsula for Oregon silverspot.
- Determine appropriate strategies such as prescribed fire or tree removal to maintain the natural vegetation of coastal bogs used by Makah (Queen Charlotte) copper.
- Enforce zoning and shoreline management regulations to protect spawning beaches and other nearshore habitat for surfsmelt and Pacific sand lance.
- Establish buffers to conserve forests bordering shorelines and consider policies to encourage reforestation of degraded shoreline areas for surfsmelt.
- Work with local authorities at Tokeland on northern Willapa Bay to maintain roosting sites for marbled godwit and willet.
- Maintain and enforce Forest Practice rules protecting bald eagle roost sites and nests.
- Continue to require bald eagle habitat plans that require retention of trees.
- Protect important roost sites and hibernacula for Townsend's big-eared bat.
- Maintain alpine areas and suitable nesting and foraging habitats for golden eagle.
- Maintain and restore lupine in open areas used by Puget (Blackmore's) blue butterfly.
- Protect sites with known populations of ***Oregon megomphix***.
- Protect suitable breeding lakes for common loons from development and recreational pressure.
- Manage small fish populations in lakes with nesting common loon.
- Conserve prey populations of golden eagles by reducing deliberate control programs.
- Prioritize conservation areas using ecoregional assessments and other biological assessments. Protect important habitat types, biodiversity areas, and environmentally sensitive lands that should not be altered through a variety of techniques including acquisitions, conservation easements, life estates and cooperative agreements with willing landowners.
- Coordinate with local land trusts, conservation districts and other conservation organizations and agencies to conserve important habitat on both public and private land. Focus limited resources in regionally significant areas. Identify all possible acquisition and restoration grants and coordinate applications.
- Work with the USDA Forest Service and other public landowners to protect existing roadless areas and expand the roadless area network where justified for habitat protection and connectivity.
- Protect key connectivity areas and wildlife corridors between fragmented habitats and between protected areas through a variety of techniques including acquisitions, conservation easements, life estates and cooperative agreements with willing landowners. Use statewide land cover and threats data layers to improve connectivity between priority conservation areas.
- Restore native habitats, habitat connectivity and wildlife corridors where appropriate on both public and private lands. Consider restoring lands adjacent to existing protected areas to increase their effective size and function as wildlife habitat.



- Purchase water rights from willing sellers in unregulated tributaries; use these water rights to restore and maintain adequate year-round flows for both instream and out-of-stream riparian fish and wildlife habitat.
- Rehabilitate and restore stream channels, floodplain functions, riparian habitat and connectivity where streams have been diverted, fragmented, or degraded. Use livestock exclusions, instream structures, bank modifications and other methods.
- Preserve and/or restore buffer areas in appropriate locations along tributaries and mainstem waterways to a condition that is adequate to maintain healthy, functioning riparian zones for the ecoregion's rivers and estuaries.

#### Improve land management practices:

##### **General**

- Restore mature and late-successional coniferous forests by encouraging longer harvest rotations and maintaining snags, large trees with cavities, and coarse woody debris to enhance populations of northern goshawk, marbled murrelet, northern spotted owl, Vaux's swift, pileated woodpecker, Keen's myotis, Dunn's salamander, Van Dyke's salamander, and Johnson's hairstreak.
- Evaluate effectiveness of current management practices for maintaining forest birds, including northern goshawk, marbled murrelet, northern spotted owl, Vaux's swift, and pileated woodpecker.
- Retain snags in forest harvest units and during salvage logging of burns for western bluebirds and other cavity nesters.
- Maintain stream buffers during timber harvest and conduct proper land-use management to protect habitat for Dunn's salamander, Van Dyke's salamander, Columbia torrent salamander, and bivalves.
- Maintain forest buffers around talus during timber harvest to protect habitat for Dunn's salamander and ***Van Dyke's salamander***.
- Conduct prescribed burns on grassland sites where and when needed and feasible for rare butterflies and other grassland species.
- Retain moist understory conditions during timber harvest to protect Oregon meadowfox.
- Allow natural disturbances and successional functions and processes to occur on conserved wetlands.
- Manage undeveloped publicly-owned land for conservation of priority habitats and species.



##### **Forest management**

- Protect remaining old growth hardwood and conifer stands to benefit late successional species, and manage some stands on long rotation (>200 years).
- Work with the Washington Department of Natural Resources and the Washington Forest Practices Board to develop, implement and enforce forest practices regulations to enhance biological diversity on existing state and private managed and protected areas.
- Work through the Washington Forest Practices Board and directly with forest landowners to implement forest management prescriptions, including prescribed burns, which will maintain and enhance biodiversity and natural ecosystem function. Encourage modified silvicultural prescriptions that promote local topographic, soil

and vegetative conditions. Retain snags, downed woody debris and a complement of live trees in harvested areas. Sensitive areas such as wetlands, remnant old growth and wildlife breeding sites should not be disturbed.

- Encourage the development of selective harvest policies and guidelines on both public and private forestland that will leave adequate components of old growth habitat such as large tree, snags and downed wood as habitat for associated wildlife such as fisher, northern goshawk, marbled murrelet, northern spotted owl, Vaux's swift, pileated woodpecker, Van Dyke's salamander, Dunn's salamander, and Johnson's hairstreak butterfly. Minimize logging roads and decommission them after the period of entry. Ensure that all logging and forest access roads are located in stable, non-erodible areas and outside riparian management zones.
- Ensure the integrity of riparian habitat by maintaining adequate riparian management zones along streams in all logging sites, on both public and private land.
- Support implementation and enforcement of the Washington Forest Practices Act to accomplish habitat conservation and regeneration on both state and private forestlands.
- Encourage public and private forest landowners to manage forested watersheds that maintain an appropriate mix of successional stages and provide connectivity of riparian and upland vegetation as protected travel corridors for wildlife.

### **Grazing and agricultural practices**

- Work with public and tribal and management agencies to fence or otherwise protect riparian zones from livestock grazing and unauthorized offroad vehicle use. Consider retirement rather than renewal of grazing leases on sensitive lands.
- Work with conservation districts, Natural Resource Conservation Service, USDA Forest Service and private landowners to implement best management practices in riparian areas and associated upland habitat in conjunction with the Conservation Reserve Program, Wetland Reserve Program and other Farm Bill programs.
- Use the Comprehensive Resource Management Plan process for large landscapes with a mix of public and private landowners to modify grazing regimes and improve grassland and understory conditions and enhance biodiversity.
- Assist private landowners in securing funding to fence riparian zones on private land. In areas where it is impractical to exclude livestock, protect habitat quality by controlling the timing and intensity of livestock grazing through regulation and landowner agreements.
- Work with private and public landowners to minimize the impacts on habitat and wildlife from modern agriculture, including agrochemical use, water use, grazing and soil erosion.

### **Control and prevent introduction of alien and invasive species:**

- Evaluate the role of timber harvest in promoting the range expansion of barred owl, which interact negatively with northern spotted owl.
- Reduce the occurrence of European beachgrass at coastal site used by snowy plover, streaked horned lark, and Siuslaw sand tiger beetle.
- Control weeds and alien grasses on native grasslands and forest balds occupied by dog star skipper, Puget Sound fritillary, and valley silverspot.
- Monitor lakes, streams and wetlands for illegal fish introductions and prohibit legal introductions to protect pygmy whitefish and Olympic mudminnow.



- Control and monitor introduced bivalves and other aquatic invasives through enforcement and education to protect western floater, winged floater, and Oregon floater.
- Continue programs to control and eradicate *Spartina* spp., especially in Willapa Bay, to protect foraging habitat for red knot.
- Avoid introduction of non-native fish in fishless lakes and where species of conservation concern occur such as bull trout, native amphibians and reptiles.
- Trap and kill European starlings and house sparrows near current and past nesting areas of purple martin.
- Develop a regional plan for the detection, rapid response and eradication of invasive species.
- Work with other public agencies and private agricultural organizations such as the Farm Bureau and Washington Grange to develop basic techniques for mapping and monitoring the spread of invasive plant species over time.
- Participate in federal and state agency partnerships to develop and implement weed control strategies for impacted sites and ecosystems. Promote adequate funding and coordination of weed control efforts on both public and private lands using environmentally sound methods.
- Develop educational and public information materials to increase public awareness of the ways that invasive alien species are introduced to sensitive ecosystems.
- Provide funding, incentives and technical assistance to private landowners to eliminate undesirable invasive plant species in riparian zones and to restore native plants that provide important habitat for native fish and wildlife. Use integrated pest management practices to control currently established invasive species with help from volunteers.
- Participate in federal and state agency partnerships to develop and implement weed control strategies for impacted sites and ecosystems.
- Continue to focus state, federal and private efforts on eradicating *Spartina* in Puget Sound and bays on the outer coast.
- Coordinate ballast water management and treatment standards development with the U.S. Coast Guard and the International Maritime Organization to prevent or control pollution and the spread of aquatic nuisance species into Washington.

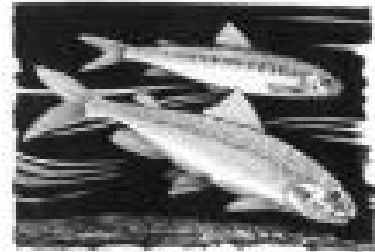
#### Control and monitor disturbance:

- Limit disruptive types of recreational activity in beach areas to prevent disturbance of nesting snowy plover and streaked horned lark.
- Restrict human activity in and around breeding colonies of common murre and Cassin's auklet.
- Limit access to roost sites and hibernacula used by Townsend's big-eared bat.
- Minimize disturbance of great blue heron, bald eagle, golden eagle, and peregrine falcon nests from human activities such as development, logging, boating, and other recreational activity by restricting access to public lands as needed, working with permitting agencies to reduce levels of disturbance, and informing the public of sensitive areas and periods.
- Reduce human disturbance and coyote feeding through education to protect Olympic marmot.
- Eliminate vehicular access and campsites in conservation areas identified as sensitive habitats such as montane wetlands, bogs, prairies, and dunes.
- In sensitive habitats, manage both land and water access by using fencing, trails, elevated boardwalks, railings, seasonal restrictions, signage and livestock restrictions.

- Reduce the amount and impact of unauthorized recreational access and use on important wildlife habitat through better enforcement of existing laws, more fencing and posting of critical habitat areas, selective road closures and increased public education and information for recreational users and user groups.
- Protect nesting golden eagle, bald eagle and peregrine falcon through use and access restrictions on public lands as needed, and work with private landowners and permitting agencies to prevent blasting or construction disturbance during nesting. Inform rock climbers of sensitive periods and locations to reduce disturbance of nesting peregrine and golden eagle.

#### Control and prevent environmental contamination:

- Prevent oil spills or rapidly clean up any that occur to safeguard all marine and coastal species, including marine mammals, common loon, western grebe, waterfowl, shorebirds, alcids, streaked horned lark, and fish.
- Identify winter concentration areas of marine and coastal mammals and birds and incorporate into oil spill plans.
- Minimize contaminants entering marine waters, estuaries, and eelgrass beds, and remediate sites of known contamination to protect killer whale, Pacific harbor porpoise, tule greater white-fronted goose, brant, greater scaup, long-tailed duck, scoters (black, surf, white-winged), bald eagle, and peregrine falcon.
- Protect common loon, trumpeter swan, bald eagle, and golden eagle from lead poisoning by advocating the use of non-toxic fishing sinkers and steel shot.
- Minimize sources of freshwater pollution that harm western floater, winged floater, Oregon floater, western ridged mussel, and western pearlshell.
- Restrict the use of piscicides such as rotenone in waters with common loons and **pygmy whitefish**.
- Work with governmental and nonprofit agencies to develop an ecoregion-wide strategy for identified toxins and other pollutants: their sources, destinations and effects, and ways to reduce their discharge.
- Work with other agencies, industry and private landowners to encourage use of integrated pest management techniques and phase out the use of pesticides and herbicides.
- Clean up contaminated sites and sediments whenever possible, and prevent further toxic contamination of areas, including unconfined spoil disposal sites.
- Reduce the use of hazardous chemicals by continuing to implement the persistent bioaccumulative toxins strategy and by using a variety of best management practices and improved treatment methods.
- Continue to place a priority on actions to prevent and respond to oil and hazardous material spills.



#### Improve transportation and energy development:

- Power lines near breeding and foraging areas should be built or modified to reduce the occurrence of golden eagle and other raptor electrocutions.
- Reduce road mortality in western toads by providing road crossings near breeding sites.
- Avoid road building near breeding sites for western toad.
- Work with the Washington Department of Transportation to locate highways away from important wildlife habitats and biodiversity areas. If impacts are unavoidable,

design adequate mitigation such as underpasses, overpasses and fencing to accommodate wildlife that need passage, such as western toad.

Improve water quantity and quality:

- Provide floating nest platforms for common loon at lakes with fluctuating water levels.
- Reduce the impacts of land use practices that increase water temperature and sedimentation, thereby harming pygmy whitefish, western floater, winged floater, Oregon floater, western ridged mussel, and western pearlshell.
- Identify dams and other passage barriers that limit the movement of river lamprey, Pacific lamprey, and **green sturgeon**, and develop methods of passage past such barriers.



- Use water control structures to manage water levels in sloughs and marshes to reduce the impacts of flooding on Columbian white-tailed deer habitat.
- Manage fluctuating water levels to reduce effects on populations of western floater, winged floater, and Oregon floater.
- Manage wetland areas on public land for both high water quality and habitat value. Ensure that the water quality of inflow does not lead to deterioration of the wetland habitat.
- Where possible restore or rehabilitate the hydrology, water quality and native plant communities in degraded and disturbed wetlands. Methods should emphasize creating or restoring natural wetland functions such as conserving beaver populations and dynamic stream processes, to benefit species such as Dunn's salamander, Van Dyke's salamander, Columbia torrent salamander, western toads, and Makah (Queen Charlotte) copper. Manage runoff from highways according to the updated highway runoff manual. Improve the road drainage network in riparian zones by removing unnecessary culverts, increasing the size of inadequate culverts, or replacing culverts with bridges.
- Reduce the harm from stormwater runoff by working to improve the effectiveness of the National Pollutant Discharge Elimination System stormwater permit programs.
- Assist local jurisdictions in finding solutions to increase landowner compliance with onsite sewage system maintenance and animal waste management practices through education and regulated inspection. Work to reduce the number and volume of combined sewer overflow events.

Improve coordination, planning, permitting and mitigation:

- Strengthen the Shoreline Management Act to protect bald eagle nesting and roosting sites.
- Provide credible scientific information on priority habitats and species and biodiversity areas, their significance, management needs and compatible land uses to decision-makers at site, local and regional scales.
- Provide technical assistance to counties in using fish and wildlife and biodiversity information to update comprehensive land use plans, community or watershed plans, Shoreline Master Plan, etc.

- Assist counties in developing and updating county ordinances and incentives that help to mitigate or control development in areas with resource and conservation values and that encourage environmentally sensitive development in growth areas.
- Work with local governments and conservation organizations to identify and protect areas of important habitat and biodiversity through existing environmental laws and other local programs.
- Encourage floodplain management and shoreline zoning protection programs.
- Develop a coordinated conservation vision and strategy for conservation of large landscapes using a structured process like The Nature Conservancy's 5-S Project Management System or the Cascade Dialogs.
- Review state and federal land management plans to ensure adequate protection for priority habitats and species, biological diversity and ecosystem health.
- Develop site management plans for protected areas.
- Work with public and tribal land management agencies to protect important habitat and areas of high biodiversity from loss and fragmentation, as well as degradation.
- Coordinate and integrate species recovery and management plans with land management and watershed plans using regulatory and voluntary approaches.
- Participate in Growth Management Act, Shoreline Management Act, Forest Protection Act and Federal Energy Regulatory Commission permitting processes for new or expanded residential, recreational or hydropower development on private land.
- Use information from ecoregional assessments to illustrate important habitats and areas of high biodiversity. Encourage permitting agencies to designate and protect these areas from residential and recreational development, and to require mitigation for habitat conversion and fragmentation where it occurs.
- Work closely with the USDA Forest Service and other land management agencies to prevent or mitigate potential adverse impacts to fish and wildlife habitat from proposed recreational or hydropower development on public lands.
- Work with regulatory agencies to design effective mitigation strategies for projects that result in wildlife impacts or direct conversion or fragmentation of habitat.
- Encourage the permitting of land uses practices that protect the integrity of beach, dune, shoreline and nearshore ecosystems. Regulate and control the construction of jetties and other structures that may obstruct the natural dynamics of dune and beach habitats.
- Represent WDFW's conservation interests on interagency recovery teams and working groups.

#### Improve enforcement of laws and regulations:

- Enforce existing protections for bald eagle through vigorous investigation and prosecution.
- Enforce fishing regulations, seasons, and stream closures to protect bull trout from fishing pressure.
- Enforce recreational access restrictions on public lands and aquatic areas.

#### Improve landowner assistance:

- Develop, periodically update, and provide WDFW Priority Habitats and Species management recommendations to assist landowners in conserving priority habitats and species.
- Work with large and small timber companies and landowners to accomplish habitat conservation through nonregulatory approaches such as landowner incentives, conservation easements, habitat conservation plans and acquisition of critical habitat from willing landowners.

- Secure state and federal tax incentives that discourage habitat fragmentation and destruction and that encourage landowners to protect and manage their land to benefit wildlife habitat.
- Work with local government to implement the Public Benefit Rating System and encourage effective use of open space tax incentives for landowners.
- Work with private landowners to identify and protect areas with important habitats and biodiversity and protect these areas through landowner incentives and other nonregulatory programs. This would assist species such as great blue heron, trumpeter swan, tule white-fronted goose, northern pintail, bald eagle, snowy plover, willet, marbled godwit, Vaux's swift, pileated woodpecker, streaked horned lark, purple martin, and Siuslaw sand tiger beetle. Provide educational materials to private landowners that describe management techniques for maintaining and restoring various wildlife habitats.
- Work with private landowners to identify and protect important wetland habitats and buffers by providing adequate water, controlling invasive plants, reducing disturbance to nesting wildlife, and fencing or otherwise keeping livestock out of wetlands and associated upland habitat.
- Influence the application of federal Farm Bill funds, including the Conservation Reserve Program and the WDFW Landowner Incentive Program, on private agricultural lands most critical for wildlife movement and most suitable for restoration of native wetlands and grassland habitat.
- Promote grant programs to assist landowners with implementation of management plans.

Improve wildlife conservation education: includes outreach, volunteer and watchable wildlife programs.

- Conduct outreach and education programs to engage the public in conservation programs for many species.
- Educate the public on minimizing disturbance to great blue heron and common murre colonies during the nesting period.
- Develop education programs targeted to reduce disturbance of common loon, western grebe, greater scaup, and black oystercatcher by boaters and other human activities.
- Educate boaters to avoid disturbing killer whale and other marine mammals.
- Continue to work with tribal and non-tribal fishermen to reduce gill net entanglement of marine mammals and birds.
- Educate fishermen to reduce lesser scaup mortality from entanglement with discarded lines and nets.
- Education programs are needed to curtail recreational pressure on common loon at suitable breeding lakes.
- Establish volunteer programs for monitoring common loon activity at lakes.
- Engage and involve local and tribal governments, state and federal agencies, organizations and citizens in efforts to protect and restore priority habitats and species through a variety of outreach projects, programs and education efforts.
- Increase the use of citizen science for the collection of data, monitoring, restoration and conservation of important habitats and associated wildlife species. Coordinate volunteer monitoring and involvement.
- Promote and maintain public information and education efforts that focus on endangered species, habitat loss, ecological function, biological diversity and environmentally aware lifestyle practices. Emphasize the connection between habitat and environmental quality and human health and welfare.

- Expand conservation education programs for both adults and children to emphasize the critical nature and vulnerability of sensitive habitats such as wetlands, oak and grassland habitats and associated wildlife.
- Connect with user groups through education to make them part of the conservation solution in areas that have high recreation values.
- Work with large corporations to increase awareness and develop financial support for conservation of biodiversity.



*Black oystercatchers.*

## PUGET TROUGH ECOREGION

(Washington's portion of the  
Willamette Valley-Puget Trough-Georgia Basin Ecoregion)



### PHYSIOGRAPHY AND FISH AND WILDLIFE DIVERSITY

#### Geography

The Washington portion of the Willamette Valley-Puget Trough-Georgia Basin ecoregion unfurls in a long ribbon of broad lowland valleys and the inland sea of Puget Sound. It is flanked by the rugged Cascade Range to the east and Olympic Mountains to the west and includes the foothills of these ranges. Although the ecoregion's terrestrial elevation averages 445 feet, the effect of the adjacent mountains, ocean intrusions and glaciation during prior ice ages have caused dramatic localized differences in climate, soils and geology. The result is a diverse array of ecological communities ranging from coniferous forests to open prairies and oak savannas to various marine and estuarine environments.

#### Geology

The marine waters of the Puget Trough ecoregion consist of three natural basins that formed nearly 150 million years ago as colliding continental plates formed the deep Georgia Depression, or Georgia Basin. The Puget Lobe of the Cordilleran Ice sheet entered the Puget Sound in the late Pleistocene (about 15,000 years ago). At its maximum extent, the glacier extended south of Olympia and may have been more than 3,000 feet thick in some areas. Before the last advance of ice, known as the Vashon glaciation, Puget Sound almost certainly did not have the same shape as now. Some north-south troughs may not have existed and there may have been troughs where uplands now occur. Advance outwash deposits filled in the sounds, lakes, and valleys of the pre-glacial lowlands. The topography of these lowlands was almost entirely eroded by Vashon-age subglacial meltwater.

#### Climate

The Puget Trough ecoregion is characterized by a maritime climate with warm, relatively dry summers and mild, wet winters. Annual precipitation ranges from 25 to over 60 inches. The drier areas are caused by rain shadows from the Olympic Mountains, resulting in the



development of natural grassland and savanna communities. There are 386 mountain glaciers in the Cascades Mountains to the east, covering 116 square miles and containing 13 million acre-feet or 3.85 cubic miles of ice. To the west, there are about 266 glaciers crowning the peaks of the Olympic peninsula. The prominent glaciers are those on Mount Olympus, covering approximately ten square miles. In the summer, meltwater from these glaciers provides a steady and constant release of fresh, cold water to streams and rivers in the Puget Trough ecoregion, which is extremely important to juvenile salmon for growth and development.

### Habitat and Plant Associations

Douglas-fir forests with western hemlock and redcedar are the primary late-successional species and currently dominate the vegetation of the Puget Trough. Oregon white oak, Pacific madrone, bigleaf maple, and red alder forests are frequent components of the landscape. Grassland habitats are often associated with oak and support a number of rare species, including the federally threatened golden paintbrush and a number of butterfly species. Historically, fires set by Native Americans over the last 5,000 years maintained these native grasslands and the adjacent open oak woodlands. Many rare grassland species are declining as this landscape becomes more urbanized and fire suppression leads to more densely forested areas.

The biological diversity of the Puget Trough ecoregion is very high, ranging from the foothills of the Cascade and Olympic mountain ranges to the nearshore and deepwater environments of Puget Sound. Puget Sound is an estuary of global significance. Here the marine waters from the Pacific are diluted by thousands of rivers and streams, large and small. Each hour, aquifers, rivers and streams in the Puget Sound ecoregion release about 27 million gallons of freshwater into the marine environment. The largest river entering Puget Sound is the Skagit River.

### Marine Environment

Puget Sound's marine nearshore environment is a rich, complex, and important part of the ecoregion. The sound features a wide variety of deepwater and nearshore habitats including coastal lagoons, kelp and seagrass beds, rocky shores, sandy beaches and spits, and salt marsh wetlands. These and surrounding forests support a complex web of plants, fish and other organisms. This web of life evolved through millennia of interactions with the freshwater and saltwater environments in and around Puget Sound.

### Marine Species

More than 220 species of fish, 26 different kinds of marine mammals, 100 species of seabirds and thousands of marine invertebrate species are found in Puget Sound. Marine mammals include harbor seals, killer whales, porpoises, and California sea lions. Some of these species are migratory, while others reside year-round. Other local marine animals include many native and introduced species of shellfish, sea urchins, a number of rockfish species, and some of the largest octopus and barnacle species in the world. The nearshore and deepwater habitats of all these animals are largely hidden from view, as are impacts on them. Wild Pacific salmon, Pacific herring, scoters and harbor seals are good indicators of the health of Puget Sound's fish and wildlife populations, primarily because each occupies a very different place in the Sound's ecology.

## Terrestrial Species

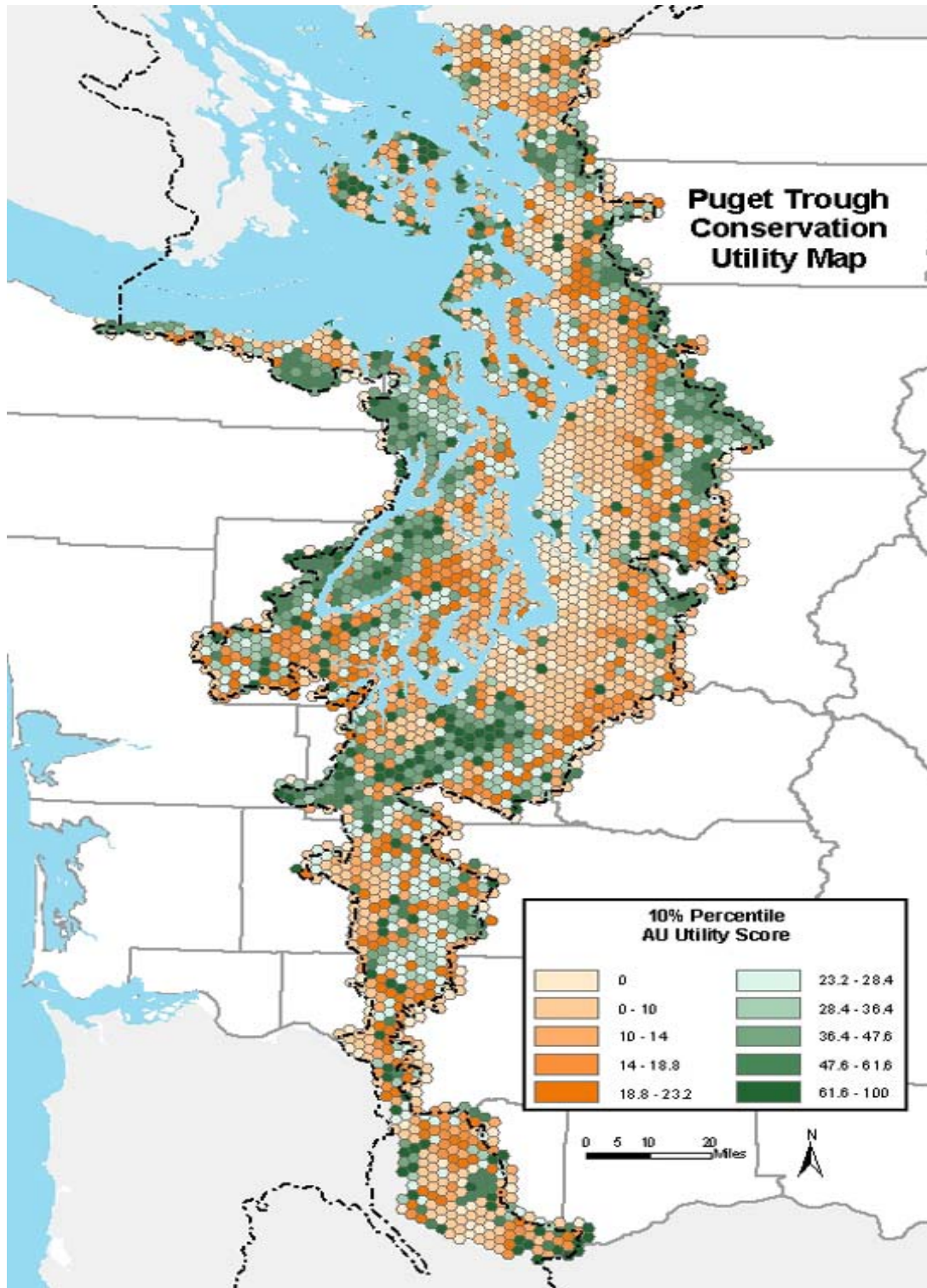
Terrestrial species are also diverse. However, a number of terrestrial plant and animal species have shown significant declines in the ecoregion over the past 100 years, primarily related to increased human development and resulting habitat loss. Population declines include amphibians endemic to the Northwest such as the Oregon spotted frog; birds such as the northern spotted owl and marbled murrelet; invertebrates including Taylor's checkerspot butterfly; mammals like the western gray squirrel; and reptiles such as the western pond turtle. Although populations of declining animals still persist in many areas, their long-term viability may be called into question as these populations become more isolated from each other by continued development and fragmentation of their habitat.



While the CWCS focuses on wildlife diversity, the ecoregional assessments address the full range of Washington's biological diversity. One product of the ecoregional assessment, the conservation utility map, depicts the relative biodiversity value of landscapes or watersheds within the ecoregion. A sample map, titled Conservation Utility Scores, is shown below for the Northwest Coast ecoregion (Figure 12). The utility scores indicate both the biodiversity value of an assessment unit (AU) and its suitability for conservation. The AU varies by ecoregion and is either a hexagon or a watershed. The scores are generated with a computer algorithm under the assumption that all AUs are not equally suitable for conservation (a suitability index was used). For instance, lands adjacent to intensive agriculture or residential development are considered less suitable for conservation than lands adjacent to undisturbed forest. The algorithm assigns a high utility score to AUs that contain rare targets (species or communities), contain a large amount of a target (i.e., has high representation of a target), or has a high number of targets (i.e., has high richness).

When a set of AUs have similar biological contents, the algorithm uses the suitability index to choose the best AU from the set. AUs with a score of 100 are either irreplaceable or are the most suitable place to conserve particular targets. Refer to Appendix 12 for a description of how these maps were developed.

Figure 17.



## LAND OWNERSHIP AND POPULATION

The intimate relationship between the forest and the sea is perhaps demonstrated better in the Puget Trough than in any other region of United States. Although altered and under stress, both the terrestrial and marine environments are still extremely productive. In many places, modern land use conversion has had a major impact on native biodiversity.

### Land Use

Rural areas in the Puget Trough are managed largely for intensive industrial and private forestry, and pasture and cropland are still dispersed throughout the ecoregion. Much of the ecoregion has grown into one long metropolitan area from Everett to Olympia, including the major Pacific Rim ports of Seattle and Tacoma, as well as industrial complexes and smaller communities such as Bellingham and Mt. Vernon. Most of the dense lowland coniferous forest was cut and converted long ago, and few sizeable mature forest areas remain.

### Population

Consistent and continued rapid growth of the human population is a central issue for the Puget Trough ecoregion. Washington's population was approximately 520,000 in the year 1900. In 2000, the population had grown to 5.9 million, an increase of more than 1100%. About 75% of Washington's population lives in the Puget Trough ecoregion, from Bellingham to Olympia. In the southern part of the ecoregion, Clark County's population increased by 33% between 1990 and 1997, the highest in the state for that period. The ecoregion's population is expected to reach 5 million by 2020. In 1999, nearly 3.9 million people lived in the Puget Sound ecoregion – double the population of the mid-1960s. This region has been experiencing incredible urban expansion over the last decade, and projections indicate much of the same into the foreseeable future.

Population growth in the Puget Trough ecoregion will result in more cars that will further degrade water and air quality; more energy generated and consumed; greater demand for land for houses, business and transportation corridors, leading to development of previously rural or resource production land; increased demand for forest products, minerals, and gravel and rock pits; increased need for treatment and disposal of solid waste, sewage and storm water; a greater challenge to provide a clean and adequate supply of drinking water; more crowded recreation areas such as parks, beaches and wilderness areas; and more stress on native wildlife and habitats. Figure 18 below maps land ownership classes for the Puget Trough ecoregion.



# **Puget Trough Ecoregion** **Land Ownership Classes**

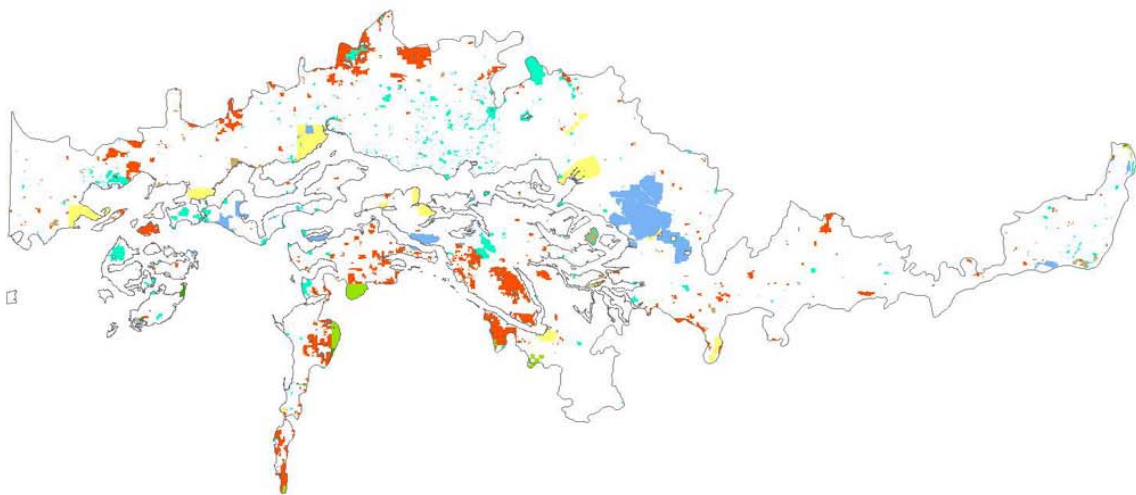
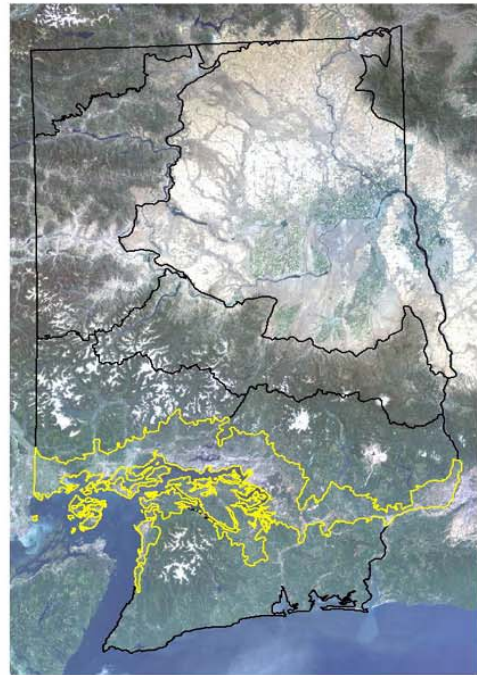
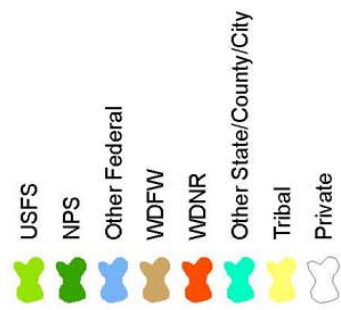


Figure 18.

## ECOREGIONAL CONSERVATION PARTNERSHIPS

Effective conservation of fish, wildlife and biodiversity in Washington requires close coordination and cooperation with many public and private conservation partners. Major partners in the Puget Trough ecoregion include:

- U.S. Fish and Wildlife Service (Nisqually National Wildlife Refuge, San Juan Islands National Wildlife Refuge, Ridgefield National Wildlife Refuge)
- U.S. Forest Service (Mt. Baker-Snoqualmie National Forest)
- U.S. Department of Defense (Fort Lewis, McChord Air Force Base, Naval Station Everett, Whidbey Island Naval Air Station, Bangor Naval Submarine Base)
- Washington Department of Natural Resources (WDNR)
- Washington Department of Ecology
- Washington State Parks and Recreation Commission
- Puget Sound Action Team
- Northwest Indian Fisheries Commission
- Interagency Committee/Salmon Recovery Funding Board
- Pacific Coast Joint Venture
- San Juan, Whatcom, Skagit, Snohomish, King, Pierce, Thurston, Lewis, Cowlitz, and Clark counties

The Washington Department of Fish and Wildlife also works closely on conservation projects with private conservation partners such as The Nature Conservancy, Trust for Public Land, Cascade Land Conservancy, Audubon Washington, People for Puget Sound, Ducks Unlimited and a growing number of fisheries enhancement groups and local land trusts.

### Major Plans and Assessments

A number of ongoing or completed planning efforts involving WDFW and its public and private partners guide the conservation and management of fish and wildlife resources statewide and in the Puget Trough ecoregion. Important planning efforts affecting conservation in the Puget Trough ecoregion include:

- Elochoman and Cowlitz Subbasin Plans (2004)
- Forest Practices Habitat Conservation Plan (WDNR)
- National Estuary Program (NEP) Comprehensive Conservation and Management Plan
- Nearshore Fishery Management Plan
- Northwest Forest Plan (1994)
- Partners in Flight Conservation Plans
- Puget Sound and Adjacent Waters Program
- Puget Sound Restoration Program
- Puget Sound Water Quality Work Plan
- Shared (Salmon) Strategy for Puget Sound
- USFWS Columbian White-tailed Deer Recovery Plan (1983)
- USFWS Draft Bull Trout Coastal/Puget Sound DPS Recovery Plan (2004)
- USFWS Draft Northern Spotted Owl Recovery Plan (1992)
- USFWS Marbled Murrelet Recovery Plan (1997)
- Washington Forest Practices Board Wildlife Strategy (in progress)
- Washington Forests and Fish Agreement (1999)
- WDFW Aquatic Nuisance Species Management Plan
- WDFW Bald Eagle Status Report (2001)
- WDFW Bull Trout and Dolly Varden Management Plan (2000)

- WDFW Draft Mazama Pocket Gopher, Streaked Horned Lark and Taylor's Checkerspot Status Report (2005)
- WDFW Draft Puget Trough Regional Wildlife Area Management Plan
- WDFW Fisher Recovery Plan (2005)
- WDFW Forage Fish Management Plan (1998)
- WDFW Larch Mountain Salamander Status Report (1993)
- WDFW Marbled Murrelet Status Report (1993)
- WDFW Mardon Skipper Status Report (1999)
- WDFW Oregon Spotted Frog Status Report (1997)
- WDFW Outline for Salmon Recovery Plans (2003)
- WDFW Peregrine Falcon Status Report (2002)
- WDFW Puget Sound Groundfish Management Plan (1998)
- WDFW Sea Otter Recovery Plan (2004)
- WDFW Steller (Northern) Sea Lion Status Report (1993)
- WDFW Western Gray Squirrel Recovery Plan (2005)
- WDFW Western Pond Turtle Recovery Plan (1999)
- Willamette Valley-Puget Trough-Georgia Basin Ecoregional Assessment

Supporting references to these and other important statewide planning documents are included in Appendices 6 and 7.



## SPECIES AND HABITATS OF GREATEST CONSERVATION NEED

This section provides a short summary of priority species and associated habitats for the Washington portion of the Puget Trough ecoregion.

### Species of Greatest Conservation Need

The following species list for the Puget Trough ecoregion is a regional subset of the statewide Species of Greatest Conservation Need (SGCN) list shown in Appendices 1 and 2. The process and criteria used to develop the statewide SGCN list are provided in Volume Two: Approach and Methods, as well as in Appendix 3. Species listed below are found in the Puget Trough ecoregion for all or part of their lifecycle. Supporting tables and information for these species and habitats can be found in Chapter IV and in Appendices 1, 2, 8, 9, 10 and 14.

COMMON NAME	Population Size/Status						Population Trend				State Status*	WNHP
	Extirpated	Critical	Low	Medium	Abundant	Unknown	Declining	Stable	Increasing	Unknown		
<b>Mammals</b>												
Keen's myotis						x				x	C	
Townsend's big-eared bat			x							x	C	
Western gray squirrel			x				x				T	
Brush Prairie pocket gopher			x							x	C	
Mazama (western) pocket gopher			x				x				C	
Shaw Island Townsend's vole			x							x	N	S1
Gray-tailed vole			x							x	C	
Killer whale			x				x				E	
Pacific harbor porpoise			x							x	C	
Steller sea lion			x				x				T	
Fisher	x							x			E	
Sea otter			x						x		E	
Columbian white-tailed deer			x						x		E	
<b>Birds</b>												
Common loon			x					x			S	
Western grebe			x				x				C	
Great blue heron			x							x	M	
Trumpeter swan			x						x		G	S3
Tule greater white-fronted goose			x							x	G	S3
Brant			x				x				G	S3
Northern pintail					x		x				G	S3
Greater scaup				x							G	S5

COMMON NAME	Population Size/Status						Population Trend				State Status*	WNHP
	Extirpated	Critical	Low	Medium	Abundant	Unknown	Declining	Stable	Increasing	Unknown		
Lesser scaup				x			x				G	S4
Long-tailed duck			x				x				N	S3
Black scoter			x				x				G	S4
Surf scoter				x			x				G	S3
White-winged scoter			x				x				G	S5
Bald eagle				x					x		T	S4
Northern goshawk			x							x	C	S3
Golden eagle			x							x	C	S3
Peregrine falcon			x						x		S	S2
Black oystercatcher			x					x			M	S2
Marbled godwit			x							x	N	S3
Red knot			x				x				N	S3
Rock sandpiper			x				x				N	S3
Arctic tern						x				x	M	S2
Common murre				x			x				C	S4
Marbled murrelet			x				x				T	S3
Ancient murrelet			x							x	N	S3
Cassin's auklet				x			x				C	S3
Tufted puffin			x				x				C	S3
Yellow-billed cuckoo	?									x	C	SH
Northern spotted owl			x				x				E	S1
Vaux's swift			x				x				C	S3
Pileated woodpecker				x						x	C	S4
Streaked horned lark		x								x	N	S1
Purple martin			x					x			C	S3
Slender-billed white-breasted nuthatch		x					x				N	S1
Western bluebird			x				x				M	S3
Oregon vesper sparrow			x				x				N	S1
<b>Reptiles</b>												
Western pond turtle			x						x		E	S1
Racer	?									x	N	S5
Sharptail snake			x							x	C	S2
Pacific gopher snake	?	x								x	M	S5

COMMON NAME	Population Size/Status						Population Trend				State Status*	WNHP
	Extirpated	Critical	Low	Medium	Abundant	Unknown	Declining	Stable	Increasing	Unknown		
<b>Amphibians</b>												
Larch Mountain salamander			x							x	S	S3
Van Dyke's salamander			x							x	C	S3
Cascade torrent salamander				x						x	C	S3
Columbia torrent salamander				x						x	C	S3
Western toad				x			x				C	S3
Oregon spotted frog			x				x				E	S1
<b>Fish</b>												
River lamprey						x				x	C	S2
Pacific lamprey						x				x	N	S3
Copper rockfish		x						x			C	
Greenstriped rockfish						x				x	C	
Quillback rockfish		x						x			C	
Black rockfish			x							x	C	
China rockfish						x				x	C	
Tiger rockfish						x				x	C	
Bocaccio rockfish		x								x	C	
Canary rockfish			x							x	C	
Redstripe rockfish						x				x	C	
Yelloweye rockfish		x								x	C	
Green sturgeon				x			x				G	S2
Bull trout						x				x	C	G3
Lower Dungeness pink salmon											G	S2
Upper Dungeness pink salmon											G	S2
South Puget Sound steelhead											G	S5
North Puget Sound steelhead											G	S5
Pacific herring (Cherry Pt, Discovery Bay)		x						x			C	
Eulachon		?								x	C	S4
Olympic mudminnow						x				x	S	S2
Surfsmelt				x						x	G	G5
Salish sucker						x				x	M	S1
Pacific sand lance					x					x	N	
<b>Invertebrates</b>												
Beller's ground beetle			x							x	C	S3

COMMON NAME	Population Size/Status						Population Trend				State Status*	WNHP
	Extirpated	Critical	Low	Medium	Abundant	Unknown	Declining	Stable	Increasing	Unknown		
Long-horned leaf beetle			x							x	C	
Hatch's click beetle			x							x	N	S1
Propertius' duskywing (butterfly)			x				x				M	S3
Oregon branded skipper (butterfly)						x				x	M	S2
Mardon skipper (butterfly)		x								x	E	S1
Dog star skipper (butterfly)						x				x	N	S2
Island marble (butterfly)		x								x	N	S1
Johnson's hairstreak (butterfly)						x				x	C	S2
Hoary elfin (butterfly)						x				x	N	S3
Puget (Blackmore's) blue (butterfly)			x				x				N	S2
Puget Sound fritillary (butterfly)						x	x				N	S3
Valley silverspot (butterfly)			x				x				C	S2
Taylor's checkerspot (butterfly)		x					x				C	S1
Great arctic (butterfly)	?					x				x	C	SH
Sand-verbena moth			x				x				N	S1
Pacific clubtail (dragonfly)			x							x	N	S1
Western floater (bivalve)			x				x				N	S1
Western ridged mussel			x				x				N	S2
Western pearlshell				x			x				N	S4
Bluegray taildropper (slug)		x					x				N	S4
Oregon megomphix (snail)			x				x				N	G2

\* Status Codes

E = endangered  
T = threatened  
S = sensitive  
C = candidate  
M = monitor

\*\* WNHP Codes (S = state, G = global)

1 = critically imperiled  
2 = imperiled  
3 = vulnerable to extirpation or extinction  
4 = apparently secure  
5 = demonstrably widespread, abundant and secure

### Species Conservation in the Puget Trough Ecoregion

Species of Greatest Conservation Need (SGCN) found in the Puget Trough ecoregion (see table above) include those classified by WDFW as Endangered, Threatened, Candidate or Monitor species, as well as species identified by WDFW as needing additional research or funding attention. Conservation actions are recommended for these species at both the statewide and ecoregional levels. These recommended conservation actions are summarized in a series of matrices included in Chapter IV and as Appendices 9 and 10. These matrices also display the life history, population status and distribution of these species.

### Ecoregional Habitat Overview

The Puget Trough ecoregion was historically dominated by dense coniferous forests of western red cedar, western hemlock, and Douglas-fir. Tree species on drier sites included Douglas-fir, Oregon white oak, Pacific dogwood, and Pacific madrone. Some prairie and bog communities were scattered throughout the ecoregion and the numerous islands and inlets were surrounded by a variety of nearshore habitats. Although altered and under stress, both the terrestrial and marine environments are still extremely productive. Most of the dense lowland coniferous forest was cut and converted long ago, and few sizeable unlogged forest areas remain. The larger prairie areas in the southern portion of the ecoregion near Tacoma and Olympia have been largely converted by urbanization and agriculture. The U.S. Army base at Fort Lewis contains some of the largest and highest quality prairie communities left in the ecoregion. Many of the interior wetlands have been developed, but some still remain intact. Figure 19 below maps wildlife habitat classes for the Puget Trough ecoregion.

The following major habitat types classified, coded and described in Wildlife and Habitat Relationships in Oregon and Washington (WHROW) are present in the Puget Trough ecoregion. In the next section, descriptions are provided for priority habitats associated with Species of Greatest Conservation Need found in this ecoregion.

- Westside Lowlands Conifer-Hardwood Forest
- Westside Oak and Dry Douglas-fir Forest and Woodlands
- Montane Mixed Conifer Forest
- Westside Grasslands (Prairie)
- Agriculture, Pasture and Mixed Environs
- Urban and Mixed Environs
- Open Water: Lakes, Rivers, Ponds and Reservoirs
- Herbaceous Wetlands
- Westside Riparian-Wetlands
- Montane Coniferous Wetlands
- Coastal Dunes and Beaches
- Coastal Headlands and Islets
- Bays and Estuaries
- Inland Marine Deeper Waters
- Marine Nearshore

## Puget Trough Ecoregion

### Wildlife Habitat Classes

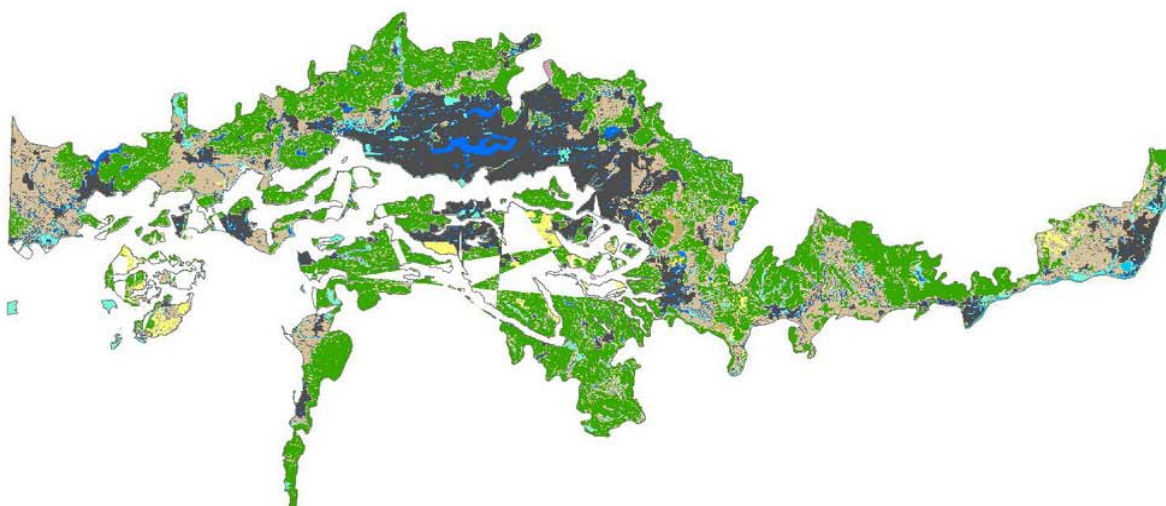
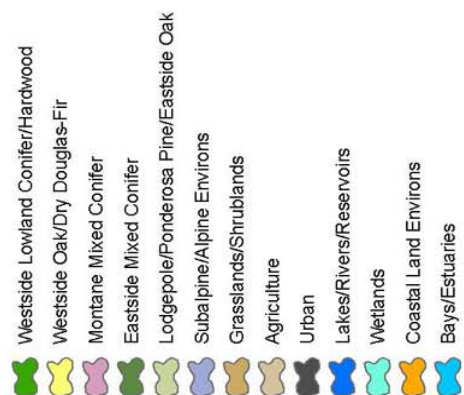


Figure 19.



### Priority Habitats in the Puget Trough Ecoregion

The following six habitat types have been identified as the highest priority for current conservation action in the Puget Trough ecoregion. Selection of these habitats as a priority was determined by their importance to regional Species of Greatest Conservation Need, as well as priorities outlined in the Puget Trough Ecoregional Assessment and the subbasin plans listed in the “Major Plans” section above. More discussion on the selection of priority habitats is included in Chapter III: Statewide Overview and in Volume Two, Approach and Methods.

- Inland Marine Deeper Waters, Bays and Estuaries, Marine Nearshore
- Westside Grasslands
- Westside Oak and Dry Douglas-fir Forest and Woodlands
- Westside Riparian-Wetlands
- Herbaceous Wetlands
- Westside Lowlands Conifer-Hardwood Forest

### **Bays and Estuaries, Inland Marine Deeper Waters, and Marine Nearshore**

The marine systems of Puget Sound, Strait of Georgia, Hood Canal and the Strait of Juan de Fuca significantly define the climate, habitats and animals found in the greater Puget Trough ecoregion. The abundance of tidal salt water creates a home for a wide variety of resident and migratory marine fish and mammals.

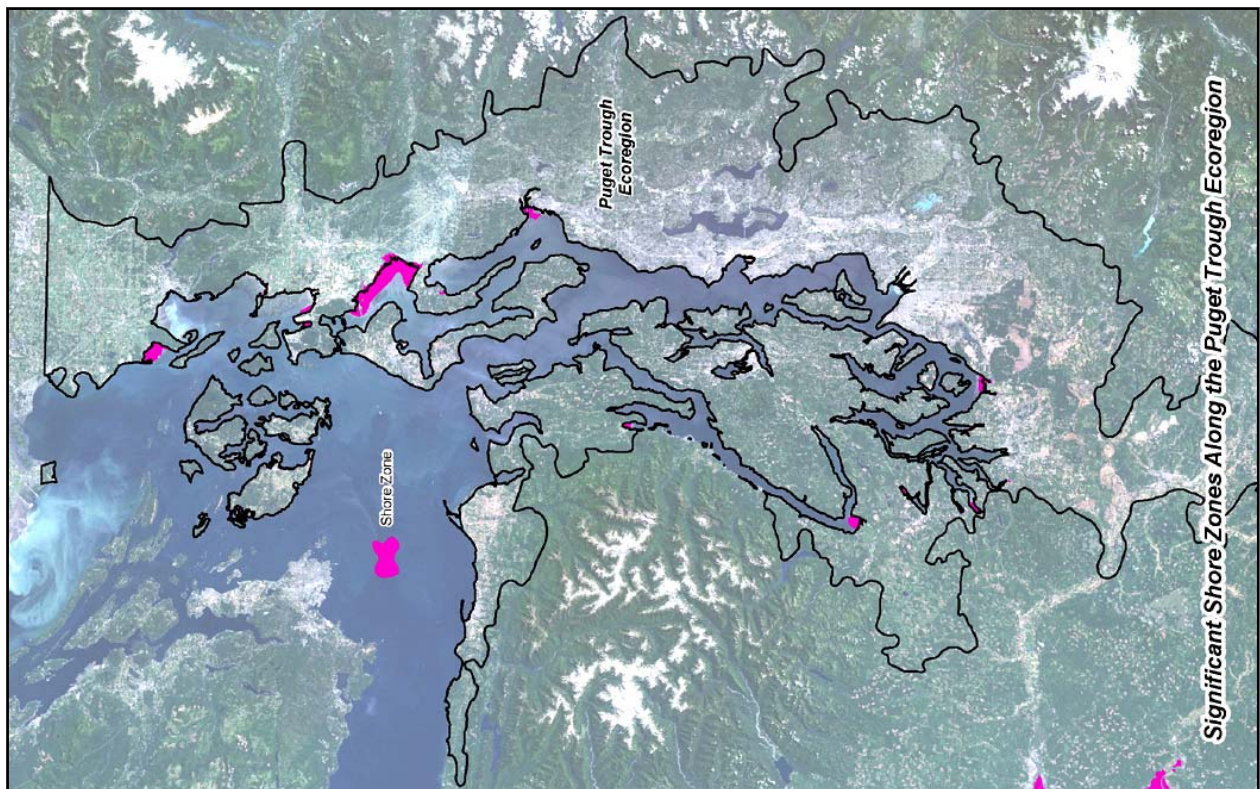
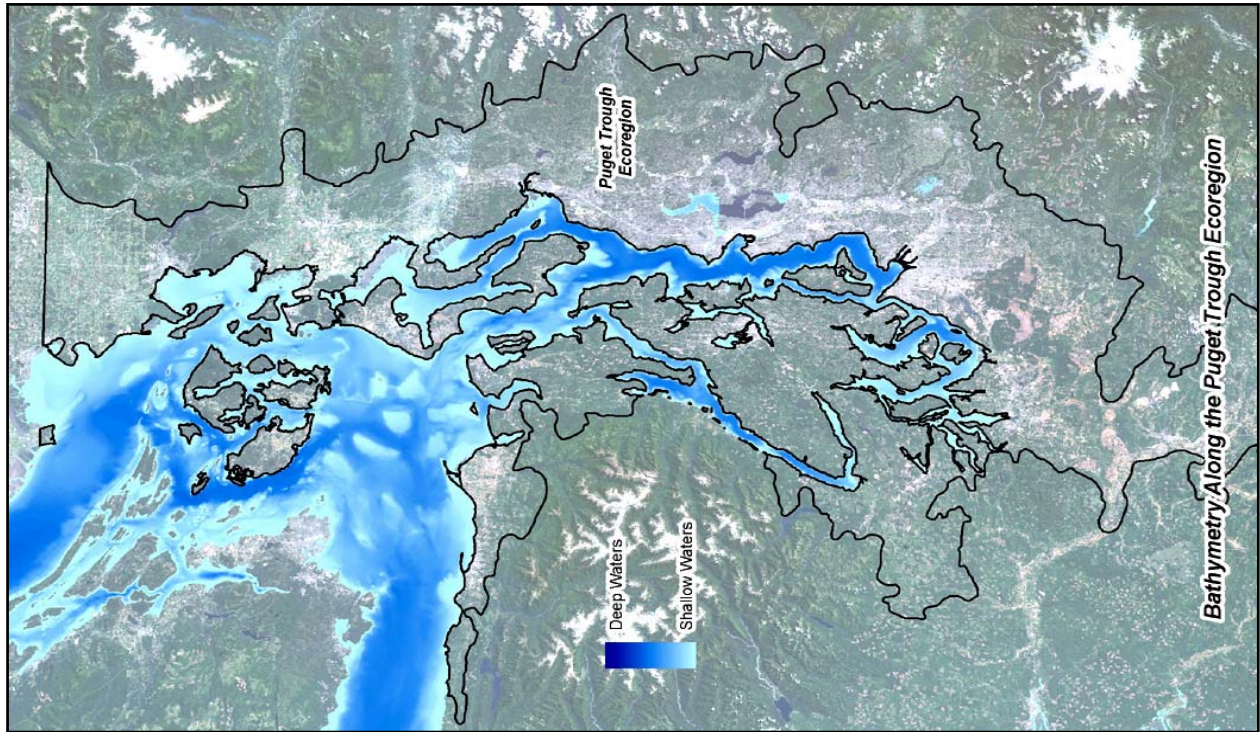
Kelp beds, eelgrass meadows, salt marshes, rocky shores, beaches and tidal flats are vital to the biodiversity and health of Puget Sound. They provide critical habitat for wildlife populations of great biological and economic value, including shellfish, salmon, marine ground fish, seabirds and marine mammals.

Freshwater rivers and streams drain from lands surrounding these inland marine waters to create nearshore estuarine environments. Estuarine habitat reflects the interface between land and sea, and is also the site of intense commercial and navigational activities such as seaports, marinas, ferry docks, and log booms. Estuaries are considered by many to be the most productive ecosystems in the world, supporting diverse populations of plants and animals. Because many marine and terrestrial species depend on these ecosystems during all or a portion of their life cycles, estuaries are often referred to as “nurseries of the sea”. Juvenile and adult fish species, including salmon, require estuaries as transition areas on their journey to the ocean. Degree of wave and current action, substrate, availability of sunlight, and presence of vegetation diversify nearshore subtidal habitats. Figure 20 below maps marine features of the Puget Trough ecoregion.

Selected Species Closely Associated with Marine Habitats in the Puget Trough Ecoregion	
Killer whale	Common loon
Pacific harbor porpoise	Western grebe
Brant	Yelloweye rockfish
Marbled murrelet	Pacific herring
Pacific sand lance	Surfsmelt



Figure 20. Marine features of the Puget Trough ecoregion.



## Westside Grasslands

This is one of the rarest ecosystems in the United States. Open prairies were created by retreating glaciers 15,000 years ago, which scoured some areas and in others left behind gravelly soils that dried out quickly during summer droughts. These prairies are areas of locally low annual precipitation, excessively drained soils, and exposure to dry southwest winds. The defining features of the woodland/prairie mosaic are native grasslands interspersed with groves of trees that include species characteristic of dry conditions such as Oregon white oak. This habitat type is found in the dry southern parts of some of the San Juan Islands, the Sequim-Dungeness area, and part of Whidbey Island as well as the prairies in the southern Puget Trough near Olympia and Tacoma. Native prairies in the south Puget Sound area occur on gravelly soils derived from glacial outwash. Woodlands and native grasslands on the San Juan Islands are often on shallow, rocky ground scoured by glaciers.

About fifty species of butterflies can be found on prairies in the Puget Trough ecoregion, including seven that depend on prairies for food and habitat. Populations of the Mazama pocket gopher, which may require specific types of prairie soils, are also disappearing in the Puget Trough ecoregion. The intertwining of oak woodland, coniferous and wetland habitats also provides an ideal landscape for a variety of reptile and amphibian species.

### **Selected Species Closely Associated with Westside Grasslands in the Puget Trough Ecoregion**

Gray-tailed vole	Mazama (western) pocket gopher
Taylor's checkerspot	Oregon branded skipper butterfly
Streaked horned lark	Mardon skipper butterfly
Oregon vesper sparrow	Puget (Blackmore's) blue butterfly
Western pond turtle	Island marble butterfly

## Westside Oak and Dry Douglas-fir Forest and Woodlands

Oregon white oak is Washington's only native oak. Although limited and declining, oaks and their associated flora comprise distinct woodland ecosystems. The various plant communities and stand age mixtures within oak forests provide valuable habitat that contributes to wildlife diversity in the Puget Trough ecoregion. In conjunction with other forest types, oak woodlands provide a mix of feeding, resting, and breeding habitat for many wildlife species. More than 200 vertebrate species and a profusion of invertebrate species use Washington's oak woodlands. Some species occur in especially high densities, whereas others are not typically found in Washington. Several rare and declining animal species are found exclusively in association with Oregon white oak. The elusive western gray squirrel, listed as threatened in Washington, dwells among the oaks, using them for food and relying on their extensive canopies as aerial pathways. Recent surveys have shown this species to be declining precipitously in the ecoregion. Oaks woodlands provide essential habitat for other oak-dependent species that are state listed as Sensitive, Threatened, Endangered, candidates for these listings, or that are locally extirpated. This habitat also includes dry Douglas-fir forests, as well as Pacific madrone/Douglas-fir forests and local areas of lodgepole pine.



**Selected Species Closely Associated with  
Westside Oak and Dry Douglas-fir Forest and Woodlands  
in the Puget Trough Ecoregion**

Western gray squirrel	Western bluebird
Proterops' duskywing butterfly	Puget Sound fritillary butterfly
Slender-billed white-breasted nuthatch	

### **Westside Riparian-Wetlands**

Freshwater systems in the Puget Trough ecoregion include a variety of still water (lakes, ponds) and riparian habitat types influenced by highly variable geology and dramatic moisture and elevation gradients. Most of the streams entering Puget Sound originate in glacier fields high in the Cascade and Olympic mountain ranges.

Forested riparian habitat usually has an abundance of snags critical to cavity-nesting birds and mammals and to many insect-eating birds. Downed logs provide cover and nesting habitat for amphibians, reptiles and small mammals. Intact riparian habitat has well-developed vegetation, usually with multiple canopy layers. Each layer consists of unique habitat niches that together support a diversity of birds and mammals. The relatively mild microclimate of riparian areas offers relief from hot, dry summers and cold winters, a factor which is especially important to black-tailed deer and elk. Riparian habitat forms natural corridors, providing important travel routes between foraging areas, breeding areas and seasonal ranges.

### **Herbaceous Wetlands**

Herbaceous wetlands are generally a mix of emergent herbaceous plants and grasses. They include ponds, marshes, and seasonally flooded meadows. These meadows often occur with deep or shallow water habitats with floating or rooting aquatic forbs. Herbaceous wetlands are generally flat, usually with stream or river channels or open water nearby. They are often associated with Westside riparian-wetlands, and along stream corridors. They also occur in closed basins in a mosaic with open water by lakeshores or ponds. Wetlands are among the most biologically productive ecosystems in the world; they host unique and diverse species populations, many of which are endangered or threatened. They are associated with every terrestrial habitat in the ecoregion and contribute essential wildlife resources to each of those habitats. Herbaceous wetlands serve as natural water filters, allowing silt to settle out and trapping other pollutants. Consequently, they protect offshore water resources from siltation and pollution. They also serve as natural flood control zones, able to accommodate large amounts of water without suffering damage. Freshwater marshes are among the most susceptible of all herbaceous wetlands to human-induced impacts. They are easily drained or filled because they are often small and have low water levels.

**Selected Species Closely Associated with  
Westside Riparian-Wetlands and Herbaceous Wetlands  
in the Puget Trough Ecoregion**

Western pond turtle	Pacific lamprey
Trumpeter swan	North Puget Sound steelhead
Yellow-billed cuckoo	South Puget Sound steelhead
Hatch's click beetle	Salish sucker
Beller's ground beetle	Pacific clubtail dragonfly
Oregon spotted frog	Long-horned leaf beetle
Western toad	

### **Westside Lowlands Conifer-Hardwood Forest**

The Westside lowlands conifer-hardwood forest zone occupies the lowlands around Puget Sound. It is the most extensive habitat in the lowlands on the west side of the Cascades, and forms the matrix within which other habitats occur as patches, especially riparian-wetlands. This forested habitat is dominated by Douglas-fir, western hemlock, western redcedar, red alder and bigleaf maple. All of these species except the short-lived red alder are capable of exhibiting dominance and persisting for at least a few hundred years. Eventually a multi-layered canopy will develop and be well expressed by stand age 200-400 years. Throughout this habitat, western hemlock tends to increase in importance as stands mature.

This forested habitat is the wintering area for numerous birds that breed in more northerly climates, at higher elevations in the surrounding mountains, or on the east side of the state. The most important areas of this forested habitat for wildlife and biodiversity are the remaining stands of mature timber (80- $\geq$ 200 years old), of which only five percent (5%) remain in the Puget Trough ecoregion. Most of this remaining mature timber is in federal or state ownership.

The central and southern Kitsap Peninsula, eastern Jefferson County, northwestern Snohomish County, and northern Clallam County probably have the greatest potential for improving biodiversity protection within this mature forest habitat while maintaining connectivity with surrounding zones. The Nisqually River corridor currently serves as a relatively unbroken wildlife link between the Nisqually Glacier on Mount Rainier and the Nisqually Delta. The Tiger Mountain-Squak Mountain-Rattlesnake Mountain "lobe" of the West Cascades ecoregion extends further into the greater Seattle area than any other expanse of largely forested land and major public-private efforts are underway to permanently protect this "Mountains to the Sound" corridor from development and fragmentation. The mostly agricultural corridor along and between the White and Green Rivers is also being engulfed by housing and industrial development, and is unlikely to contribute to recovery of the Westside lowlands-conifer hardwood forest habitat type.

**Selected Species Closely Associated with  
Westside Lowlands Conifer-Hardwood Forest  
in the Puget Trough Ecoregion**

Keen's myotis	Northern spotted owl
Purple martin	Oregon megomphix (snail)
Marbled murrelet	Blue-gray tailed dropper
Northern goshawk	Johnson's hairstreak

## **CONSERVATION PROBLEMS**

Since most of Washington's human population is concentrated in the Puget Trough ecoregion, there are a variety of human activities and land uses that have contributed to habitat loss and degradation, including incompatible forest and grazing practices, conversion of habitat to agriculture, urbanization, dispersed residential development, pollution, overfishing and overhunting, water extraction, incompatible mining, hydropower and energy developments and transportation systems. These developments disturb and displace wildlife, disrupt migration corridors, and encourage the establishment of invasive plant and animal species.

### **Marine and Nearshore Habitats**

The three most significant problems for the marine and nearshore environments are loss of natural shoreline and estuary habitat and habitat degradation, pollution and invasive species. Approximately 47% of Puget Sound estuarine wetlands have been lost from diking and draining for agriculture, industrial and urban development. Some evidence of ecosystem harm is shown in the high incidence of closed shellfish harvest areas, the list of polluted water bodies, the salmon populations listed under the Endangered Species Act, and the disappearance of forage fish and eelgrass in areas of shoreline modification.

#### **Shoreline Modification**

The most serious long-term problem for the Puget Sound environment is shoreline modification. Population growth and resulting development have modified natural shorelines and other critical areas, compromising and eliminating the ecological functions they provide.

Shoreline modification such as bulkheading, filling, and dredging can lead to direct habitat loss and changes in the sediment and wave energy on beaches and in adjacent subtidal areas. Alterations in the physical characteristics of the beach will eventually affect species dependent on the shoreline for survival. One third of Puget Sound's shorelines, approximately 800 miles, have been modified. The central Puget Sound region, with high human population levels, shows the highest level of modification overall at 52%. In the last 100 years, over 73% of tidal wetlands and perhaps as much as 33% of eelgrass beds have been lost to dredging, filling and diking.

#### **Environmental Contamination**

Large portions of Puget Sound's 1.8 million acres of submerged sediments show some form of chemical or biological degradation. More than 5,700 acres have been classed as contaminated because they exceed the Washington state sediment management standards. Some of this contaminated acreage may naturally recover without remediation if the sources of contamination are controlled. Contaminated underwater sediment sites are concentrated in the major urban bays, including Commencement Bay (Tacoma), Elliott Bay (Seattle), Bellingham Bay, Bremerton, and other bays with extensive histories of industrial activities. The contaminated sites on land are widely scattered, as were the oil storage facilities, dry cleaners, creosote plants and other activities that caused the contamination.

Toxic substances threaten the Sound's rich marine diversity. Seals and other marine mammals in Puget Sound have high levels of polychlorinated biphenyls (PCBs), fire retardants (PBDEs), and other toxins. Juvenile salmon from rivers with contaminated bays

show higher levels of toxins than fish from clean estuaries. A high percentage of adult salmon returning to certain urban streams are dying before they spawn. Although some toxic compounds have been banned, continuing sources of toxins include industrial and municipal discharges, oil spills, hazardous material spills, seepage from hazardous sites on land, illegal discharges and dumping activities. Stormwater runoff from roads, parking lots and other impervious surfaces further degrades the shoreline environment.

### Alien and Invasive Species

Once established, aquatic nuisance species are expensive to control and almost impossible to eradicate. Non-native species can enter inland waters in many ways, including accidental releases from research institutions and laboratories, aquaculture operations, the aquarium trade, discharge of ballast water from vessels, and the distribution of seafood commodities.

## **Forest Habitats**

### Habitat Loss and Degradation

Historically, most of the Puget Trough ecoregion was covered in conifer forest. Over 50% of these conifer forests have been converted to urban and agricultural use. Many of the remaining forests are now hardwood and mixed conifer. Approximately 30,000 acres of forest a year is converted from forest management to developed uses in the Puget Trough ecoregion. This is a more profound and final disturbance than the logging of the original old-growth forest. It is also more detrimental to water, wildlife and fisheries resources. Accelerated erosion, more severe and frequent landslides, and other types of environmental degradation are occurring as a result of urbanization. Urban development increases runoff and adds pollutants to affected watersheds, particularly septic field drainage, herbicides, and pesticides. Over the last 30 years, more than 2.3 million acres of forest land have been converted to urban, residential, commercial and transportation uses in the Puget Trough ecoregion. Remaining stands of native conifer forest are usually small and widely fragmented, further compromising their value as wildlife habitat.

### Management Practices

Forest management practices including clearcutting, slash burning, herbicide applications, disease control, salvage logging, plantation forestry, road building, and short harvest rotations have resulted in a loss of forest diversity in both individual stands and at the landscape scale throughout the Puget Trough ecoregion. Most of the remaining habitat is now in private Douglas-fir plantations, and intensive logging of both mature and young stands continues on both private and public land.

## **Westside Grasslands and Oak Woodlands**

### Habitat Loss and Fragmentation

More than 90% of historic prairie habitat has been converted to other uses, and this destruction continues today as prime prairie is replaced by housing developments or agriculture. Only seven prairie areas, a total of less than 6,000 acres, have been set aside for conservation. Activities such as improperly managed grazing, soil compaction, trampling, etc. may also degrade prairie and oak woodlands.



The remaining native prairies/oak woodland mosaics are small and isolated from each other. This makes it difficult for wildlife to travel between prairie/oak woodland environments to access food resources and to breed and disperse. Plant populations may also have difficulty dispersing. Fragmentation greatly increases the difficulty of restoring natural ecological processes in the prairie landscape.

Decades of human settlement and intensive land use in the Puget Trough ecoregion have altered substantial amounts of lowland forest and prairie/oak woodlands habitat. Most of the original South Sound oak woodlands are gone. Only scattered fragments of oak woodlands survive, some just a few acres or a few trees in size. Management practices: Encroachment by native Douglas-fir is a significant threat to remaining oaks and is aggravated by urban development, fire suppression, timber conversion and improperly managed cattle grazing.

Grazing is a primary use of oak woodlands in Western Washington. Grazing reduces species richness of ground cover, increases soil moisture, compacts soils, and disturbs sod, all of which may promote conifer growth and encroachment.

Fire suppression has contributed to the decline of Oregon white oak woodlands and prairies. Fires set by Native Americans historically played an important role in prairie and oak forest ecology, especially natural oak regeneration, by curbing conifer encroachment, controlling stand density, and initiating oak sprouting.

#### Alien and Invasive Species

All remaining prairie/oak habitats, both privately and publicly owned, are under stress from encroachment by both native and alien plants. Invasive plants such as Scot's broom, Himalayan blackberry, mouse-ear hawkweed, and pasture grasses are of particular concern because they can change the composition, structure and ecological processes of native plant communities. In the absence of fire, even native woody and herbaceous species such as Douglas-fir, wild rose, snowberry and bracken fern invade. Fire is a part of the native prairie ecology, and the suppression of fires can lead to conditions where Douglas-fir trees form dense stands that are rarely used by wildlife species that inhabit the open structure of prairies or savannas.

#### Riparian and Wetland Habitats

Freshwater riparian and wetland habitat has been, and continues to be, altered in the Puget Trough ecoregion. Whether they are cleared, inundated, built upon, or overtaken by non-native species, these disturbed areas no longer provide habitat for dependent plants and animal species. When they no longer function as habitat, they also may no longer help hold soil in place, soak up water or filter pollutants.

#### Habitat Loss and Fragmentation

Habitat loss and fragmentation of essential riparian habitat from urban and rural development are occurring throughout the Puget Trough ecoregion, with a cumulative negative impact on unique and valuable fish and wildlife resources. Other human activities and land uses that have contributed to degradation and fragmentation of riparian habitat include agriculture, chemical treatments, improperly managed grazing, dikes and culverts, roads, stream crossings and ever-increasing recreational demands.

### Grazing Practices

Improperly managed grazing and livestock trampling decrease native aquatic plants and facilitate the introduction of invasive species, both native and non-native, eventually converting wetlands into low-productivity pasture.

### Invasive Alien Plants and Animals

Invasive plants and animals continue to threaten the diversity and/or abundance of native species, the ecological stability of infested waters, and the commercial, agricultural or recreational activities that depend on such waters. Aquatic nuisance species have little or no habitat value for native wildlife, and once established they are very expensive to control and almost impossible to eradicate.

### Water Quality

Water quality is significantly impacted by urbanization that generates problems such as untreated and excessive stormwater runoff, septic leachate, sediment, nutrients and pesticides (weed and feed), heavy metals, garbage, and groundwater pumping. Modern agricultural practices include heavy use of pesticides, fertilizers and concentrated livestock waste that reduce water quality. Impairment of water quality or quantity will particularly affect plant species diversity and amphibian, salmonid and bird populations, as well as carry secondary impacts to other wildlife species.

### Disease and Pathogens

Disease can decimate vulnerable wildlife populations. With the reduction and fragmentation of habitat concentrating some wildlife populations and reducing other populations to low levels, disease can become a limiting factor. This increases the opportunity for diseases like plague, avian cholera or botulism to extract a heavy toll. Widespread environmental treatment of organisms that carry disease, such as spraying for mosquito-borne West Nile virus, must be carefully planned and executed to avoid massive mortality of non-target species.

The following additional habitat and species conservation problems have been identified in the Puget Trough ecoregion:

Wildlife species and population problems: includes disease, pathogens, competition, food scarcity, predation, overharvest, and limited population size and distribution.

- Populations of sea otter, southern resident killer whale, Steller sea lion, fisher, western gray squirrel, Columbian white-tailed deer, western pond turtle, Oregon spotted frog, marbled murrelet, northern spotted owl, and mardon skipper have declined to the point where they are listed as threatened or endangered. Fisher are extinct in the Puget Trough.
- Recovery plans are needed to guide conservation actions for threatened or endangered species including southern resident killer whale, northern spotted owl, Oregon spotted frog, and mardon skipper.
- Management plans are needed for the sensitive species including common loon, peregrine falcon, and Olympic mudminnow. State sensitive species need to be managed to avoid becoming threatened or endangered.

- Small population size and loss of genetic diversity is a problem in Western gray squirrels, and mange can cause high mortality in populations.
- In addition to species listed as threatened or endangered, many other species are found at a small number of isolated sites and may be affected by inbreeding or otherwise at risk of local extinction, including streaked horned lark, Oregon vesper sparrow, slender-billed white-breasted nuthatch, Mazama pocket gopher, Brush Prairie pocket gopher, gray-tailed vole, Shaw Island Townsend's vole, Keen's myotis, island marble, Taylor's checkerspot, hoary elfin, Pacific clubtail, blue-gray tailedropper, Beller's ground beetle, Hatch's click beetle, long-horned leaf beetle, sand-verbena moth, Salish sucker and Olympic mudminnow.
- The great arctic (butterfly) was historically known from the San Juan Islands, but there have been no records since 1950.
- Steller sea lion are vulnerable because of the small number of haul outs that are used.
- Elk compete with Columbian white-tailed deer for food.
- Predation from gulls and introduced mammals at breeding colonies may impact populations of common murre and Cassin's auklet.
- Predation of nests by crows may be an important mortality factor for streaked horned lark.
- Illegal persecution and harvest occurs for bald eagle and migrating and spawning fish species of concern.
- Rockfish (copper, greenstriped, quillback, black, China, tiger, bocaccio, canary, redstriped, yelloweye) are caught as bycatch in the recreational salmon fisheries and are vulnerable to overharvest; when rockfish are pulled up from depth, their gas bladders extend, likely causing internal damage and mortality.
- Overharvest is a problem for Pacific herring (Cherry Point and Discovery Bay stocks), green sturgeon and bull trout. Quantitative stock assessment and annual estimate of the total stock size of eulachon is needed in order to estimate the harvest rate.
- Populations of rockfish predators including seals, sea lions, lingcod, and other piscivorous fish are increasing.
- The decline in some salmon stocks likely affects southern resident killer whale.
- Pacific harbor porpoise are affected by incidental mortality in gill nets, salmon trolls, or hake trawls.
- Steller sea lion, sea otter and western grebe are negatively impacted by entanglement in gill nets and other fishery gear.
- Commercial fisheries and shellfish harvest may reduce important prey species for Steller sea lion, sea otter and common murre. The timing of kelp harvest may affect some organisms.
- There is potential for overharvest of northern pintail, greater scaup, lesser scaup, long-tailed duck, and scoter (black, surf, white-winged).

Lack of biological information on species and habitats:

- Data are needed on population trends in state threatened and endangered species including sea otter, southern resident killer whale, Steller sea lion, fisher, western gray squirrel, Columbian white-tailed deer, western pond turtle, Oregon spotted frog, marbled murrelet, northern spotted owl, and mardon skipper.
- Populations of the peregrine falcon, which has been downlisted to sensitive, and bald eagle, which may soon be downlisted to sensitive, need to be monitored to confirm their continued recovery.
- Additional sensitive species need to be surveyed periodically to ensure they do not become threatened, including common loon and Olympic mudminnow.

- Information is needed about the status of populations of state candidate species including Townsend's big-eared bat, Keen's myotis, Mazama pocket gopher, Brush Prairie pocket gopher, gray-tailed vole, Pacific harbor porpoise, western grebe, common murre, Cassin's auklet, tufted puffin, Vaux's swift, northern goshawk, pileated woodpecker, purple martin, slender-billed white-breasted nuthatch, Oregon vesper sparrow, yellow-billed cuckoo, sharp-tail snake, western toad, Van Dyke's salamander, rockfish (copper, greenstriped, quillback, black, China, tiger, bocaccio, canary, redstriped, yelloweye), bull trout, eulachon, river lamprey, Beller's ground beetle, Hatch's click beetle, long-horned leaf beetle, Taylor's checkerspot, Johnson's hairstreak, valley silverspot, island marble, Puget (Blackmore's) blue, and great arctic.
- Research is needed on habitat needs, limiting factors, demographics and dispersal in western gray squirrel, Mazama pocket gopher, streaked horned lark, Oregon spotted frog, Taylor's checkerspot and mardon skipper to facilitate recovery planning or reintroductions.
- Information is needed on the current distribution and abundance of many other species, including Shaw Island Townsend's vole, great blue heron, mountain quail, black oystercatcher, tule greater white-fronted goose, scoters, western bluebird, Salish sucker, green sturgeon, Pacific lamprey, Oregon branded skipper, dog star skipper, propertius duskywing, hoary elfin, Puget Sound fritillary, sand-verbena moth, Pacific clubtail, western floater, western ridged mussel, western pearlshell, blue-gray tailedropper, and Oregon megomphix.
- Data are needed on effects of contaminants and limiting factors for southern resident killer whale and other marine mammals.
- Areas used by all rockfish life history stages and movements of juveniles before selection of adult habitat are largely unknown.
- There is insufficient information to conduct rockfish population assessments within Puget Sound; harvest needs to be appropriately scaled to the anticipated run size.
- There is a pressing need to conduct research on deep-water zones in Puget Sound. Information on substrates and bathymetry, salinity, currents, sea surface temperature and productivity might be combined to create a model for offshore ecosystems. Survey efforts are also needed to verify the condition and biodiversity value of nearshore marine zones.
- Thorough mapping of kelp and eelgrass beds is needed.
- Taxonomic and/or genetic work needs include: formally describe Salish sucker; western toad taxonomy is uncertain, so one or more taxa may be in greater decline; the long-horned leaf beetle may be synonymous with *Plateumaris dubia*; data is needed on genetic diversity and gene flow in bull trout.
- Information is needed on the population dynamics and the impact of dredging on the spawning grounds, incubating eggs, and larvae of eulachon.
- The causes of decline of tufted puffin, western toad and eulachon are unknown.
- Information is needed on the impacts of development on the Salish sucker.
- Life history other than spawning of the surf smelt is not known.
- Adequate fishery statistics are generally lacking for recreational surfsmelt fisheries, in spite of their local importance.
- There is no comprehensive data set for an adult sand lance population in the Puget Sound basin.
- There is a shortage of adequate spatial inventory and assessment data on most habitat types.
- There is an absence of baseline data on the habitat values and functions of natural wetlands and a poor understanding of the status of resident macroinvertebrates in aquatic systems.

#### Habitat loss, conversion, fragmentation and degradation:

- Only 3% of western Washington forest is currently in the old growth age class, and nearly all of it is in high elevation national forests or national parks. Maintenance of old growth forest across the landscape is important for at least 1,000 species.
- Suburban sprawl is a concern for resource managers, as indicated by the growing number of ranchettes and residential subdivisions in previous managed forest and cropland. Development often occurs near lakes or streams and poses an increased threat of fire and impacts to water quality.
- Grassland conversion, recreational use, and rural development has resulted in loss or degradation of habitat of the Mazama pocket gopher, Brush Prairie pocket gopher, Shaw Island Townsend's vole, streaked horned lark, mardon skipper, Taylor's checkerspot, Puget Sound fritillary, valley silverspot, Oregon branded skipper, dog star skipper, hoary elfin, and Puget (Blackmore's) blue.
- Loss, fragmentation and degradation of oak and mixed oak/conifer habitats by encroachment of conifers and development affect western gray squirrel, Propertius' duskywing, slender-billed white-breasted nuthatch, hoary elfin and other oak-dependent wildlife.
- Development or other land uses that degrade or alter hydrology can eliminate bog habitat of Beller's ground beetle and long-horned leaf beetle.
- Degradation of shorelines by residential development can eliminate nesting habitat for common loon and bald eagle. Urbanization and industrialization of coastal shorelines, bays and estuaries have degraded some winter habitat and reduced food abundance for long-tailed duck and scoter.
- Continued clearing of woodlands adjacent to high value foraging areas reduces great blue heron populations.
- Loss of suitable riparian habitat may be responsible for decline of yellow-billed cuckoo.
- Development or other land uses alters hydrology and can eliminate bog or wetland habitat of Oregon spotted frog, Beller's ground beetle, Hatch's click beetle and long-horned leaf beetle.
- The loss of forest habitat to development has affected populations of fisher, northern spotted owl, marbled murrelet, northern goshawk, Vaux's swift, pileated woodpecker, Keen's myotis, Johnson's hairstreak, blue-gray tailedropper, and Oregon megomphix.
- Flooding of habitat can be a problem for Columbian white-tailed deer.
- Loss of trumpeter swan, northern pintail and tule greater white-fronted goose foraging habitat due to development of agricultural lands.
- Drainage of wetlands and conversion to agriculture and degradation of marshes impact northern pintail, tule greater white-fronted goose, lesser scaup, Oregon spotted frog, and Olympic mudminnow.
- The decline of eelgrass beds has negatively impacted brant.
- Any changes in management of Jetty Island, Everett, may affect nesting arctic terns; human activity on the island and at waterfront nest locations may impact nest success.
- Surfsmelt and Pacific sand lance spawning habitats can be damaged or destroyed by physical burial due to armoring bulkhead/fill structures intruding into the intertidal zone from adjacent uplands, alteration or disruption of the natural erosion, and longshore transport of beach substrate (the "longshore drift").
- The habitat quality of surfsmelt spawning beaches used during the hot summer months may be degraded by the routine deforestation of the marine-riparian zone during the course of shoreline development.

- Sandy habitat of sand-verbena moth is being degraded by stabilization by vegetation, and lost to recreational development.

#### Incompatible land management practices:

- Logging of mature/old timber and reduction in abundance of snags may negatively impacts populations of northern spotted owl, marbled murrelet, northern goshawk, Vaux's swift and pileated woodpecker and Keen's myotis. Reduction in occurrence of mistletoe likely affects Johnson's hairstreak.
- Improperly managed grazing may impact habitat of mardon skipper, valley silverspot, Taylor's checkerspot, Puget Sound fritillary, Mazama pocket gopher and Brush Prairie pocket gopher.
- Lack of fire on grassland and in prairie/oak woodland edges allows invasion by Douglas-fir, shrubs, and non-native vegetation, degrading habitat of mardon skipper, Oregon branded skipper, dog star skipper, Taylor's checkerspot, Puget Sound fritillary, valley silverspot, Puget (Blackmore's) blue, streaked horned lark, Oregon vesper sparrow, and western bluebird.
- Logging, conversion to conifers and firewood cutting in oak habitats may have negatively impacted western gray squirrel, Propertius' duskywing, slender-billed white-breasted nuthatch and other oak dependent species.
- Reduction of snags in clearcuts, ecotones, oak savannah, affects western bluebird and slender-billed white-breasted nuthatch.
- Decline in moist forest floor conditions and coarse woody debris in stands of bigleaf maple or mixed hardwood-conifer stands apparently has eliminated populations of blue-gray tailed dropper and Oregon meadow pipit.
- Spraying of BTK can impact butterflies including Taylor's checkerspot, Johnson's hairstreak, mardon skipper, Oregon branded skipper, dog star skipper, Puget Sound fritillary, valley silverspot and Puget (Blackmore's) blue.
- Logging, agriculture, road building or other activities that elevate temperature, alter hydrology and increase sedimentation degrade habitat of Olympic mudminnow, Salish sucker, and bull trout.
- Modern agricultural practices have reduced the quality, patch size and connectivity of wildlife habitat in farmlands.

#### Alien and invasive plant and animal species:

- *Spartina* cordgrass, European green crabs and the Asiatic clam are some of the alien plant and animal species that pose a threat to the marine environments of Puget Sound.
- Purple loosestrife, knotweeds and reed canary grass can take over a wetland and grow so densely that no other plants can survive, which in turn affects the fish and wildlife that depend on the native plants for food and cover.
- Alien grasses and weeds affect habitat of mardon skipper, Taylor's checkerspot, Puget Sound fritillary, Puget (Blackmore's) blue, valley silverspot, and other grassland butterflies.
- Western gray squirrel are negatively affected by competition from non-native eastern gray and fox squirrels.
- *Spartina* spp., a non-native cordgrass, is spreading and degrading intertidal shorebird and waterfowl habitat.
- Scot's broom, alien grasses and weed invasion affect habitat of mardon skipper, Taylor's checkerspot, Puget Sound fritillary, valley silverspot, Oregon branded skipper, Dog star skipper, hoary elfin, Puget (Blackmore's) blue, streaked horned lark, and Oregon vesper sparrow.



- Scot's broom and European beachgrass are degrading sandy coastal habitat of the sand-verbena moth by increasing vegetation stabilization of sandy areas.
- Bullfrogs and introduced predator fish such as bass prey on young western pond turtle and Oregon spotted frog. Non-native predator fish also negatively affect Olympic mudminnows.
- Non-native turtles threaten western pond turtle through competition and the potential for introduced disease.
- Non-native trout such as brook trout compete with, and may hybridize with, bull trout.
- House cats kill Mazama pocket gopher, and probably Brush Prairie pocket gopher and Shaw Island Townsend's vole as well.
- Competition for nest cavities in snags and birdhouses by European starling and house sparrow impact purple martin and western bluebird.
- Filbert worms and other alien pests affect acorns needed by western gray squirrel and other wildlife species.
- Barred owl have expanded their range and are replacing northern spotted owl in many locations.
- Nutria have expanded their range into the Puget Trough ecoregion, and they compete with and displace native muskrats. Nutria feeding habits can also be quite destructive to wetland vegetation; by selectively foraging on vegetative root mats, they uproot entire plants, loosen soil and contribute to erosion.



#### Human disturbance and recreational impacts:

- Human disturbance can be a significant problem for breeding sites of great blue heron, peregrine falcon and bald eagle, and at breeding or maternity roosts and hibernacula of Townsend's big-eared bat.
- Recreational boating can create disturbance problems for loons, brant, greater scaup and foraging bald eagle; eagles often avoid foraging in water around stationary boats.
- Disturbance of black oystercatcher, common murre and Cassin's auklet nesting sites by kayakers, boaters, fisherman, and low flying aircraft may reduce fledging rate.
- Military training and activities sometimes disturb nesting streaked horned lark, and can impact Taylor's checkerspot and other butterflies, and result in soil compaction that likely negatively affects Mazama pocket gopher.
- Bog habitats of Beller's ground beetle, Hatch's click beetle and long-horned leaf beetle are sensitive to human trampling.
- Recreational disturbance of grassland sites likely negatively impacts mardon skipper, Taylor's checkerspot, Puget Sound fritillary, valley silverspot, and Puget (Blackmore's) blue by crushing eggs, larvae, pupae, and host plants.
- Mazama pocket gopher and Brush Prairie pocket gopher are poisoned and trapped by landowners and killed by cats and dogs.
- Vessel disturbance and noise can disturb southern resident killer whale and Pacific harbor porpoise.
- Mortality of lesser scaup from fishing nets and lines may be substantial.
- Gill net fisheries result in the accidental bycatch of sizable numbers of common murre, ancient murrelet, Cassin's auklet, and tufted puffin.
- Trampling damage to host plants of sand-verbena moth may occur on public beaches.
- Recreational activities such as offroad recreational vehicles, horses, mountain bikes, and even hikers can create unauthorized trails that disturb soil and allow invasive plants to establish.
- The nature and timing of farm disturbances are increasingly hazardous to wildlife. Tilling, planting and harvesting are more synchronous, widespread and intense, thus stressing wildlife during critical periods of nesting, rearing and dispersal

#### Environmental contaminants

- Lead fishing sinkers poison common loon, and trumpeter swan are poisoned by lead shot ingested on wintering grounds.
- Pacific harbor porpoise, rockfish (coppers, quillback), southern resident killer whale, bald eagle and peregrine falcon accumulate persistent toxins such as DDE, PCBs, PBDEs, dioxins, furans, organochlorines and heavy metals; contamination from prey causes reduced reproduction of bald eagles on the Columbia River. Eagles and falcons concentrate persistent chemicals that can cause eggshell thinning.
- Chemical contamination such as oil spills, DDE and PCBs and heavy metal accumulation in winter food supplies may affect reproductive success of brant, greater scaup, long-tailed duck, scoters and common murre.
- Steady shipping traffic and associated oil spills pose a risk to birds (loons, grebes, brant, long-tailed duck, scoters, black oystercatcher, willet, red knot, rock sandpiper, arctic terns, common murre, ancient murrelet, Cassin's auklet, tufted puffin), mammals (southern resident killer whale, Pacific harbor porpoise, Steller sea lion, sea otter), and fish (surfsmelt, Pacific sand lance).
- Plastic pollution and ingestion at sea is widespread in tufted puffins, but detrimental effects have not been documented.

- The spraying of BTK to eradicate gypsy moth infestations could eliminate populations of rare butterflies, such as mardon skipper, Taylor's checkerspot, Puget Sound fritillary, valley silverspot, Oregon branded skipper, dog star skipper, and Puget (Blackmore's) blue.

Incompatible transportation and energy development:

- Dams and other passage barriers negatively affect bull trout, green sturgeon, river lamprey and Pacific lamprey, and water level manipulations from hydroelectric dams can affect nesting loons.
- Roadkill mortality is a problem for western toad, western pond turtle, salamanders, and Columbian white-tailed deer.
- Bald eagle and other raptors are susceptible to electrocution on powerlines.

Inadequate water quantity and quality:

- Development, logging, road construction, and improperly managed grazing that contribute to sedimentation, increases in water temperature and pollution runoff affect bull trout, Olympic mudminnow, green sturgeon, Salish sucker, Pacific clubtail, western floater, western ridged mussel, and western pearlshell.

## CONSERVATION ACTIONS

Conserve and recover wildlife species and populations: includes population management, protect known populations, augmentation and reintroduction of populations, control and monitor mortality and enhance food/prey.

- Implement recovery actions for the western gray squirrel, fisher, sea otter, Steller sea lion, Columbian white-tailed deer, marbled murrelet, western pond turtle, and bull trout.
- Develop or complete recovery plans for southern resident killer whale, northern spotted owl, Oregon spotted frog, bull trout and mardon skipper.
- Develop management plans for the state sensitive species including common loon, peregrine falcon, and Olympic mudminnow.
- Evaluate other species for possible addition to the state candidate list.
- Continue head starting, captive breeding, and reintroductions of western pond turtle.
- Assess feasibility of augmenting populations of western gray squirrel, Taylor's checkerspot and mardon skipper and conduct translocations as needed.
- Complete the Washington Bat Conservation Plan.
- Implement and enforce restricted fishing regulations to protect green sturgeon and bull trout.
- Maintain conservative hunting regulations for northern pintail, greater scaup, lesser scaup, long-tailed duck, and scoters.
- Rebuild salmon stocks to restore many ecosystem parts and processes, including southern resident killer whale.
- Minimize competition between elk and Columbian white-tailed deer with fencing and transplants.
- Conduct limited predator control to reduce coyote predation of Columbian white-tailed deer fawns.
- For rockfish (copper, greenstriped, quillback, black, China, tiger, bocaccio, canary, redstriped, yelloweye), reduce harvest encounters, restrict retention, and establish Marine Protected Areas or other types of area-gear restrictions.
- Pacific herring (Cherry Point and Discovery Bay stocks): develop and implement management plan to control harvest. Develop a method to determine the abundance of each year's run size so that harvest may be appropriately scaled to the anticipated run size.
- Manage fisheries harvests to reduce competitive impacts on seabirds
- Conduct crow, gull and mammal control programs, if needed and feasible, to protect common murre and Cassin's auklet colonies, and streaked horned lark.
- Implement eulachon management plan to control harvest. Develop a method to determine the abundance of each year's run size so that harvest may be appropriately scaled to the anticipated run size.
- Conserve beaver populations and dynamic stream processes to benefit Oregon spotted frog, birds and fishes.
- Assess and map important habitats and areas of high biodiversity in the ecoregion using ecoregional assessments, Interagency Vegetation Mapping Project, and other habitat inventories and plans. Update Ecoregional Assessments every five years.
- Develop statewide land cover and threats data layers to improve connectivity between priority conservation areas.
- Identify and assess key connectivity areas and wildlife corridors between fragmented habitats and between protected areas. Restore habitat connectivity and wildlife corridors where appropriate on both public and private lands.

- Improve understanding of the ecological processes of seeps, bogs, wet meadows, forested wetlands, marshes, springs and other wetlands, and how they are impacted by human development.
- Conduct hydrologic studies that include water quantity and chemical budgets at wetlands known to be supporting rare and endangered species. Use this information to inform wetland management.
- Inventory and prioritize riparian habitat types and attributes needing protection and conservation.
- Identify important habitats for restoration and assess the feasibility of successfully restoring these sites. Include an evaluation of current and projected land use in and adjacent to potential restoration sites.
- Coordinate the collection and analysis of data on alien species, shoreline modifications, trends in kelp beds and other indicators of ecosystem health in Puget Sound.
- Develop a cohesive, priority-driven research program for westside grassland habitats that integrates university, agency and private researchers. Inventory of important grassy and herbaceous balds. Work with land management agencies and private landowners to protect these habitats from disturbance and development.

Conduct research, assessment and monitoring: includes species and habitat distribution, abundance, limiting factors, suitable habitat and population trends.

- Monitor the population trends of the sea otter, southern resident killer whale, Steller sea lion, fisher, western gray squirrel, Columbian white-tailed deer, western pond turtles, Oregon spotted frog, marbled murrelet, northern spotted owl, bull trout and mardon skipper to determine if recovery objectives are being met.
- Determine the status of candidate species including Townsend's big-eared bat, Keen's myotis, Mazama pocket gopher, Brush Prairie pocket gopher, gray-tailed vole, Pacific harbor porpoise, western grebe, common murre, Cassin's auklet, tufted puffin, Vaux's swift, northern goshawk, pileated woodpecker, purple martin, slender-billed white-breasted nuthatch, Oregon vesper sparrow, yellow-billed cuckoo, sharp-tail snake, western toad, Van Dyke's salamander, rockfish (copper, greenstriped, quillback, black, China, tiger, bocaccio, canary, redstriped, yelloweye), eulachon, river lamprey, Beller's ground beetle, Hatch's click beetle, long-horned leaf beetle, Taylor's checkerspot, Johnson's hairstreak, valley silverspot, island marble, Puget (Blackmore's) blue, and great arctic.
- Conduct periodic surveys of sensitive species including common loon and Olympic mudminnow.
- Monitor post-downlisted populations of peregrine and bald eagle for signs of decline that could result from bioaccumulation of contaminants or other factors.
- Investigate limiting factors, the impacts of land management, demographics, and dispersal of western gray squirrel, Mazama pocket gopher, western pond turtle, streaked horned lark, Oregon spotted frog, Taylor's checkerspot and mardon skipper to facilitate recovery planning or reintroductions.
- Determine the current distribution and abundance of Shaw Island Townsend's vole, great blue heron, mountain quail, black oystercatcher, tule greater white-fronted goose, scoters, western bluebird, Salish sucker, green sturgeon, Pacific lamprey, Oregon branded skipper, dog star skipper, Propertius' duskywing, hoary elfin, Puget Sound fritillary, sand-verbena moth, Pacific clubtail, western floater, western ridged mussel, western pearlshell, blue-gray tailedropper, and Oregon megomphix. Research effective sampling techniques.
- Identify potential reintroduction sites for western pond turtle and continue reintroductions.



- Investigate foraging ecology of Steller sea lion and available prey base. Assess impact of incidental mortality from fishing gear on Steller sea lion.
- Assess burdens of toxic compounds and effects on populations and reproduction in southern resident killer whale, copper and quillback rockfish throughout Puget Sound.
- Investigate limiting factors for southern resident killer whale.
- Conduct studies to identify factors that are responsible for the recent declines in eulachon and western toads.
- Research habitat needs and limiting factors, predation and trophic relationships of river lamprey and Pacific lamprey.
- Identify potential obstacles to lamprey, green sturgeon, and bull trout and develop methods to pass barrier.
- Evaluate the effects of timber harvest at landscape scale on occupancy of habitat by northern spotted owl and barred owls.
- Investigate the systematics of western toad, Salish sucker, long-horned leaf beetle, western floater, western ridged mussel, and western pearlshell using DNA or other techniques.
- Develop standard survey protocol to monitor populations of great blue heron.
- Design and conduct extensive distribution and relative abundance surveys for Pacific sand lance. Research effective sampling techniques
- Develop methods of restoring native prairie habitats of Mazama pocket gopher, Taylor's checkerspot, mardon skipper, Puget (Blackmore's) blue, Puget Sound fritillary, valley silverspot, and island marble.
- Determine appropriate levels of grazing for mardon skipper and pocket gopher sites.
- Determine extent of mortality of **western grebe**, tufted puffin, and other species from gillnet fishery.
- Investigate the relationship between oceanic regimes and other ocean occurrences and smelt run strength in Pacific herring (Cherry Point and Discovery Bay), and eulachon.
- Monitor population trends of rockfish predators including seals, sea lions and lingcod (particularly where rockfish populations show some recovery). Investigate food habits and trophic dynamics.
- Conduct focus studies on the specific habitat requirements for each rockfish life history stage. Develop methods to track and measure reproductive contribution from local populations in specific locations.
- Basic biological information needs to be gathered from a variety of surfsmelt and Pacific sand lance spawning stocks
- Conduct recreational surfsmelt fishery monitoring and fishery-independent net sampling.
- Complete a systematic inventory of all shoreline areas to document existing surfsmelt and Pacific sand lance spawning areas to facilitate regulatory habitat protection.
- Complete mapping of all kelp and eelgrass beds.





Protect, restore and connect habitats:

- Identify roosting sites for Pacific Townsend's big-eared bat and limit access to these areas. Protect and conserve preferred roost and hibernacula sites.
- Protect land around large great blue heron colonies through management agreements, conservation easement or fee title.
- Protect hydrology of known western pond turtle, Oregon spotted frog, Olympic mudminnow, and Van Dyke's salamander sites.
- Protect, remove invading trees and shrubs, and restore function to prairies, balds, and heaths and other habitats of Mazama pocket gopher, Brush Prairie pocket gopher, gray-tailed vole, Shaw Island Townsend's vole, streaked horned lark, Puget Sound fritillary, mardon skipper, Oregon branded skipper, island marble, Taylor's checkerspot, hoary elfin, Puget (Blackmore's) blue, Oregon vesper sparrow, valley silverspot from residential and recreational development through management plans, conservation agreements, easements, or acquisition and restore native vegetation.
- Preserve Beller's ground beetle, Hatch's click beetle and long-horned leaf beetle sites through management programs; protect fragile vegetation with fencing if necessary.
- Protect habitat of western gray squirrel from residential and recreational development through management plans, conservation agreements, easements, and acquisitions.
- Protect small prey fish populations and shoreline habitat at lakes where common loon nests.
- Survey for Olympic mudminnow in potential sites before issuing hydraulic permits.
- Provide floating platform nest structures for common loon where water levels fluctuate dramatically.
- Protect oak habitats for western gray squirrel, western bluebird, slender-billed white-breasted nuthatch, Propertius' duskywing, hoary elfin, etc.
- Manage grassland habitats to maintain *Lupinus albicaulis* in southern Puget Sound for Puget (Blackmore's) blue.
- Protect sites where blue-gray tailed dropper or Oregon meadowlark occur.
- Use water control structures on refuge to manage water levels in sloughs and marshes to reduce flooding of Columbian white-tailed deer habitat.
- Acquire conservation easements on agricultural lands and wetlands to maintain waterfowl habitat.
- Protect eelgrass beds and intertidal areas from destruction and human activity to conserve brant.
- Manage marine areas, bays, estuaries to reduce impacts of urbanization and industrialization, monitor prey populations for long-tailed duck and scoters.
- Work with community officials and private businesses to reduce disturbance during the nesting season and to manage Jetty Island compatible with arctic tern nesting.
- Develop conservation strategies with Fort Lewis, McChord Air Force Base, and area airports for streaked horned lark.
- Protect streaked horned lark nests on dredge spoil islands in lower Columbia, and manage spoil deposition to maintain and increase open nesting habitat.
- Install single-cavity birdhouses and gourds to enhance purple martin and western bluebird populations.
- Preserve all naturally occurring surfsmelt spawning sites by protecting overhanging, shading canopies from marine-riparian zone forests bordering the beaches.
- Maintain healthy Pacific sand lance spawning habitat by preserving erosional sediment inputs and preventing shoreline armoring.
- Encourage reforestation of degraded marine shorelines where possible to restore surfsmelt spawning habitat.

- Protect and restore unstable sandy habitat where sand-verbena moths are found; restrict access to protect host plant yellow sand-verbena as necessary.
- Prioritize conservation areas using ecoregional assessments and other biological assessments. Protect important habitat types, biodiversity areas, and environmentally sensitive lands that should not be altered through a variety of techniques including acquisitions, conservation easements, life estates and cooperative agreements with willing landowners.
- Coordinate with local land trusts, conservation districts and other conservation organizations and agencies to conserve important habitat on both public and private land. Focus limited resources in regionally significant areas. Identify all possible acquisition and restoration grants and coordinate applications.
- Work with the USDA Forest Service and other public landowners to protect existing roadless areas and expand the roadless area network where justified for habitat protection and connectivity.
- Protect key connectivity areas and wildlife corridors between fragmented habitats and between protected areas through a variety of techniques including acquisitions, conservation easements, life estates and cooperative agreements with willing landowners. Use statewide land cover and threats data layers to improve connectivity between priority conservation areas.
- Restore native habitats, habitat connectivity and wildlife corridors where appropriate on both public and private lands. Consider restoring lands adjacent to existing protected areas to increase their effective size and function as wildlife habitat.
- Purchase water rights from willing sellers in unregulated tributaries; use these water rights to restore and maintain adequate year-round flows for both instream and out-of-stream riparian fish and wildlife habitat.
- Rehabilitate and restore stream channels, floodplain functions, riparian habitat and connectivity where streams have been diverted, fragmented, or degraded. Use livestock exclusions, instream structures, bank modifications and other methods.
- Preserve and/or restore buffer areas in appropriate locations along tributaries and mainstem waterways to a condition that is adequate to maintain healthy, functioning riparian zones for the ecoregion's rivers and estuaries.
- Identify and protect all remaining high quality prairie/woodland mosaic and low-elevation mature conifer-hardwood forest.
- Implement the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) to plan and undertake large-scale restoration initiatives. Coordinate PSNERP with other restoration efforts, including the Puget Sound and Adjacent Waters Program, the Northwest Straits Commission, salmon habitat restoration through the Salmon Recovery Funding Board, and other efforts.

#### Improve land management practices:

##### **General**

- Identify and protect essential habitat through management agreements, easements, or acquisitions as needed to recover listed species including western pond turtle, Oregon spotted frog, western gray squirrel, northern spotted owl, marbled murrelet, and mardon skipper.
- Protect and restore oak and oak/conifer woodlands, oak savannah and oak/grassland ecotones for western gray squirrel, slender-billed white-breasted nuthatch, Propertius' duskywing, western bluebird, and Taylor's checkerspot.
- Protect grassland habitats of Taylor's checkerspot, Puget Sound fritillary, mardon skipper, and valley silverspot from residential and recreational development through management plans, conservation agreements, easements, or acquisition.

- Discourage intensive grazing of native grasslands that degrades habitat for Mazama and Brush Prairie pocket gopher, mardon skipper and mountain quail.
- Conduct prescribed burns on grassland sites where and when needed and feasible for Taylor's checkerspot, mardon skipper, Puget Sound fritillary, valley silverspot, and other rare butterflies.
- Buffer prairies, meadows and heaths from BTK spraying to protect mardon skipper, Taylor's checkerspot, Puget Sound fritillary, valley silverspot, and hoary elfin.
- Survey mature bigleaf maple stands and protect sites for blue-gray tailed dropper and Oregon megomphix, and protect moist conditions at all occurrences.
- Preserve Beller's ground beetle and long-horned leaf beetle sites through land purchase or management programs and protect fragile vegetation with fencing if necessary.
- Reduce mortalities of eagles and other raptors through modification of electric transmission and distribution lines where needed.
- Continue to require bald eagle habitat plans that include retention of trees. Enforce/strengthen Shoreline Management Act
- Identify and protect preferred roost and hibernacula sites for Townsend's big-eared bat and limit access to these areas.
- Allow natural disturbances and successional functions and processes to occur on conserved wetlands.
- Manage undeveloped publicly owned land for conservation of priority habitats and species.

### Forest management

- Protect remaining old growth conifer and hard stands to benefit late successional species, and manage some stands on long rotations (>200 years) as needed for northern spotted owl, marbled murrelet, Vaux's swift, pileated woodpecker, northern goshawk, Keen's myotis, western gray squirrel and Johnson's hairstreak.
- Maintain stream buffers and during timber harvest and protect hydrology of seeps, streams, wet meadows and wetlands for western pond turtle, Van Dyke's salamander, Oregon spotted frog, Olympic mudminnow, bull trout, Salish sucker, western ridged mussel, and western pearlshell. Conserve beaver populations and dynamic stream processes.
- Evaluate effectiveness of current management practices for maintaining forest species including fisher, northern spotted owl, marbled murrelet, pileated woodpecker, and Vaux's swift.
- Maintain and enforce Forest Practice rules protecting northern spotted owl nests, **marbled murrelet** and bald eagle roosts and nests.
- Protect chinquapin stands along Hood Canal and survey for chinquapin hairstreak.
- Work with the Washington Department of Natural Resources and the Washington Forest Practices Board to develop, implement and enforce forest practices regulations to enhance biological diversity on existing state and private managed and protected areas.
- Work through the Washington Forest Practices Board and directly with forest landowners to implement forest management prescriptions, including prescribed burns, which will maintain and enhance biodiversity and natural ecosystem function. Encourage modified silvicultural prescriptions that promote local topographic, soil and vegetative conditions. Retain snags, downed woody debris and a complement of



live trees in harvested areas. Sensitive areas such as wetlands, remnant old growth and wildlife breeding sites should not be disturbed.

- Encourage the development of selective harvest policies and guidelines on both public and private forestland that will leave adequate components of old growth habitat such as snags and downed wood as habitat for associated wildlife such as western bluebird, purple martin, and other cavity nesters.
- Minimize logging roads and decommission them after the period of entry. Ensure that all logging and forest access roads are located in stable, non-erodible areas and outside riparian management zones.
- Ensure the integrity of riparian habitat by maintaining adequate riparian management zones along streams in all logging sites, on both public and private land.
- Support implementation and enforcement of the Washington Forest Practices Act to accomplish habitat conservation and regeneration on both state and private forestlands.
- Encourage public and private forest landowners to manage forested watersheds that maintain an appropriate mix of successional stages and provide connectivity of riparian and upland vegetation as protected travel corridors for wildlife.

### **Grazing and agricultural practices**

- Work with public and tribal and management agencies to fence or otherwise protect riparian zones from livestock grazing and unauthorized offroad vehicle use. Consider retirement rather than renewal of grazing leases on sensitive lands.
- Work with conservation districts, Natural Resource Conservation Service, USDA Forest Service and private landowners to implement best management practices in riparian areas and associated upland habitat in conjunction with the Conservation Reserve Program, Wetland Reserve Program and other Farm Bill programs.
- Use the Comprehensive Resource Management Plan process for large landscapes with a mix of public and private landowners to modify grazing regimes and improve grassland understory conditions and enhance biodiversity.
- Assist private landowners in securing funding to fence riparian zones on private land. In areas where it is impractical to exclude livestock, protect habitat quality by controlling the timing and intensity of livestock grazing through regulation and landowner agreements.
- Work with private and public landowners to minimize the impacts on habitat and wildlife from modern agriculture, including agrochemical use, water use, grazing and soil erosion.
- Eliminate grazing in oak woodlands on public lands in the Puget Trough.

### **Control and prevent introduction of alien and invasive species:**

- Develop a regional plan for the detection, rapid response and eradication of invasive species.
- Continue programs to control and eradicate *Spartina* spp. to protect habitat value of shorebird and waterfowl habitat. Remove nutria from wetlands.
- Conduct limited control of eastern gray and fox squirrels that are competing with western gray squirrel.
- Control bullfrogs and predatory fish as needed for western pond turtle, Oregon spotted frog Olympic mudminnow, and Pacific clubtail.
- Control Scot's broom, weeds and alien grasses on native grasslands and in oak savannah for mardon skipper, dog star skipper, Oregon branded skipper, Taylor's

checkerspot, hoary elfin, Puget Sound fritillary, valley silverspot, Puget (Blackmore's) blue, slender-billed white-breasted nuthatch and western bluebird.

- Control Scot's broom, weeds, European beachgrass and other alien grasses that are degrading sandy habitat of sand-verbena moth.
- Avoid introduction of non-native fish in fishless lakes and where species of conservation concern occur such as bull trout, native amphibians and reptiles. Avoid introduction of non-native trout to protect bull trout from hybridization, competition, and predation.
- Remove European starlings and house sparrows near remaining and former purple martin and western bluebird breeding areas, or provide starling-proof boxes.
- Work with other public agencies and private agricultural organizations such as the Farm Bureau and Washington Grange to develop basic techniques for mapping and monitoring the spread of invasive plant species over time.
- Participate in federal and state agency partnerships to develop and implement weed control strategies for impacted sites and ecosystems. Promote adequate funding and coordination of weed control efforts on both public and private lands using environmentally sound methods.
- Develop educational and public information materials to increase public awareness of the ways that invasive alien species are introduced to sensitive ecosystems.
- Provide funding, incentives and technical assistance to private landowners to eliminate undesirable invasive plant species in riparian zones and to restore native plants that provide important habitat for native fish and wildlife. Use integrated pest management practices to control currently established invasive species with help from volunteers.
- Participate in federal and state agency partnerships to develop and implement weed control strategies for impacted sites and ecosystems.
- In semi-native grasslands, control habitat-modifying invasive species such as Scot's broom, pasture grasses and blackberries. On wetland edges, plant native trees and shrubs to shade out invasive plants such as reed canary grass.
- Continue to focus state, federal and private efforts on eradicating ***Spartina*** spp. in Puget Sound and bays on the outer coast.
- Coordinate ballast water management and treatment standards development with the U.S. Coast Guard and the International Maritime Organization to prevent or control pollution and the spread of aquatic nuisance species into Washington.



#### Control and monitor disturbance:

- Protect Townsend's big-eared bats and nesting areas of peregrine falcon, northern spotted owl, marbled murrelet, great blue heron and bald eagle through use and access restrictions on public lands as needed, and work with private landowners and permitting agencies to prevent blasting or construction disturbance during nesting. Inform rock climbers of sensitive periods and locations to reduce disturbance of nesting peregrines.
- Work with the U.S. Army, Air Force, and Navy to reduce mortality or disturbance of mardon skipper, Taylor's checkerspot, and other grassland butterflies, streaked

horned lark, Mazama pocket gopher, southern resident killer whale and other marine mammals.

- Eliminate vehicular access and campsites in conservation areas identified as sensitive habitats such as montane wetlands, bogs, prairies, and dunes.
- In sensitive habitats, manage both land and water access by using fencing, trails, elevated boardwalks, railings, seasonal restrictions, signage and livestock restrictions.
- Reduce the amount and impact of unauthorized recreational access and use on important wildlife habitat through better enforcement of existing laws, more fencing and posting of critical habitat areas, selective road closures and increased public education and information for recreational users and user groups.

#### Control and prevent environmental contamination:

- Facilitate use of nontoxic alternatives to lead shot and lead fishing sinkers.
- Identify and remediate sources of lead shot poisoning for trumpeter swan.
- Work with other agencies to reduce and remediate sources of contaminants entering Puget Sound to protect southern resident killer whale, Pacific harbor porpoise, greater scaup, brant, long-tailed duck, scoters, bald eagle, peregrine falcon, copper rockfish and quillback rockfish.
- Minimize risk of, and damage from, oil spills to protect marine mammals, birds, fish, and invertebrates through regulations and maintaining rapid response and clean-up capabilities.
- Identify winter concentration areas of common loon, western grebe, tufted puffin and other birds and incorporate into oil spill plans.
- Do not use piscicides to eradicate unwanted fishes in lakes or ponds with Olympic mudminnow, and where common loon nest or where good potential for colonization exists.
- Work with governmental and nonprofit agencies to develop an ecoregion-wide strategy for identified toxins and other pollutants: their sources, destinations and effects, and ways to reduce their discharge.
- Work with other agencies, industry and private landowners to encourage use of integrated pest management techniques and phase out the use of pesticides and herbicides.
- Clean up contaminated sites and sediments whenever possible, and prevent further toxic contamination of areas, including unconfined spoil disposal sites.
- Reduce the use of hazardous chemicals by continuing to implement the persistent bioaccumulative toxins strategy and by using a variety of best management practices and improved treatment methods.
- Continue to place a priority on actions to prevent and respond to oil and hazardous material spills.

#### Improve transportation and energy development:

- Where feasible remove barriers to passage for bull trout, green sturgeon, river lamprey and Pacific lamprey.
- Reduce mortalities of eagles and other raptors through modification of electric transmission and distribution lines where needed.
- Work with the Washington Department of Transportation to locate highways away from important wildlife habitats and biodiversity areas. If impacts are unavoidable, design adequate mitigation such as underpasses, overpasses and fencing to accommodate wildlife that need passage, for western gray squirrel, western pond turtle, western toad, and Van Dyke's salamander.

#### Improve water quantity and quality:

- Work with public and private landowners through education, planning and regulatory pathways to reduce sedimentation and pollution for bull trout, green sturgeon, Salish sucker, river lamprey, Pacific lamprey, western floater, western ridged mussel, and western pearlshell.
- Manage wetland areas on public land for both high water quality and habitat value. Ensure that the water quality of inflow does not lead to deterioration of the wetland habitat.
- Where possible restore or rehabilitate the hydrology, water quality and native plant communities in degraded and disturbed wetlands. Methods should emphasize creating or restoring natural wetland functions such as conserving beaver populations and dynamic stream processes to benefit species like Oregon spotted frog, Salish sucker, **western pond turtle** and Olympic mudminnow.
- Manage runoff from highways according to the updated highway runoff manual. Improve the road drainage network in riparian zones by removing unnecessary culverts, increasing the size of inadequate culverts, or replacing culverts with bridges.
- Reduce the harm from stormwater runoff by working to improve the effectiveness of the National Pollutant Discharge Elimination System stormwater permit programs.
- Assist local jurisdictions in finding solutions to increase landowner compliance with onsite sewage system maintenance and animal waste management practices through education and regulated inspection. Work to reduce the number and volume of combined sewer overflow events.
- Prevent nutrient and pathogen pollution caused by human and animal wastes by focusing efforts and resources geographically, in high-risk locations such as Hood Canal, in threatened or contaminated shellfish harvest areas, and in streams where state and local partners can carry out water cleanup plans and shellfish restoration strategies to reduce loading.



#### Improve coordination, planning, permitting and mitigation:

- Consider seasonal limitations on human activity near black oystercatcher nesting sites.
- Continue to require bald eagle habitat plans that include retention of trees. Enforce/strengthen Shoreline Management Act.
- Protect nesting bald eagle, northern spotted owl, marbled murrelet and peregrine falcon by maintaining buffer zones during nesting.
- Provide scientific information on priority habitats and species and biodiversity areas, their significance, management needs and compatible land uses to decision-makers at site, local and regional scales.
- Provide technical assistance to counties in using fish and wildlife and biodiversity information to update comprehensive land use plans, community or watershed plans, Shoreline Master Plan, etc.
- Assist counties in developing and updating county ordinances and incentives that help to mitigate or control development in areas with resource and conservation values and that encourage environmentally sensitive development in growth areas.



- Work with local governments and conservation organizations to identify and protect areas of important habitat and biodiversity through existing environmental laws and other local programs.
- Encourage floodplain management and shoreline zoning protection programs.
- Develop a coordinated conservation vision and strategy for conservation of large landscapes using a structured process like The Nature Conservancy's 5-S Project Management System or the Cascade Dialogs.
- Review state and federal land management plans to ensure adequate protection for priority habitats and species, biological diversity and ecosystem health.
- Develop site management plans for protected areas.
- Work with public and tribal land management agencies to protect important habitat and areas of high biodiversity from loss and fragmentation, as well as degradation.
- Coordinate and integrate species recovery and management plans with land management and watershed plans using regulatory and voluntary approaches.
- Participate in Growth Management Act, Shoreline Management Act, Forest Protection Act and Federal Energy Regulatory Commission permitting processes for new or expanded residential, recreational or hydropower development on private land.
- Use information from ecoregional assessments to illustrate important habitats and areas of high biodiversity. Encourage permitting agencies to designate and protect these areas from residential and recreational development, and to require mitigation for habitat conversion and fragmentation where it occurs.
- Work closely with the USDA Forest Service and other land management agencies to prevent or mitigate potential adverse impacts to fish and wildlife habitat from proposed recreational or hydropower development on public lands.
- Work with regulatory agencies to design effective mitigation strategies for projects that result in wildlife impacts or direct conversion or fragmentation of habitat.
- Encourage the permitting of land uses practices that protect the integrity of beach, dune, shoreline and nearshore ecosystems. Regulate and control the construction of jetties and other structures that may obstruct the natural dynamics of dune and beach habitats.
- Represent WDFW's conservation interest on interagency recovery teams and working groups.

#### Improve enforcement of laws and regulations:

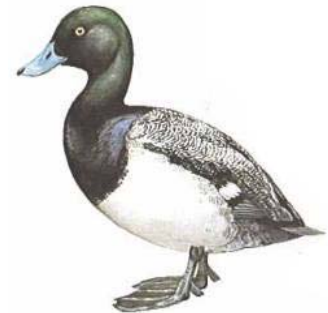
- Protect listed wildlife through enforcement, education and outreach.
- Enforce prohibition of killing bald eagle and non-permitted possession of parts through investigation and vigorous prosecution.
- Enforce restriction on transplantation of fishes to protect western pond turtle, Oregon spotted frog, bull trout, Olympic mudminnow, Salish sucker, and Pacific clubtail.
- Continue requirements on net design and daily and seasonal fishing activity of gillnetting to protect common murre, ancient murrelet, and Cassin's auklet.
- Restrict human activity in and around common murre and Cassin's auklet breeding colonies.
- Enforce zoning and shoreline management regulations and establish and enforce adequate marine riparian zone buffers for the conservation of shoreline-bordering forests to protect surfsmelt spawning areas.
- Enforce recreational access restrictions on public lands and aquatic areas.

Improve landowner assistance:

- Develop, periodically update, and provide WDFW Priority Habitats and Species management recommendations to assist landowners in conserving priority habitats and species.
- Work with large and small timber companies and landowners to accomplish habitat conservation through non-regulatory approaches such as landowner incentives, conservation easements, habitat conservation plans and acquisition of critical habitat from willing landowners.
- Secure state and federal tax incentives that discourage habitat fragmentation and destruction and that encourage landowners to protect and manage their land to benefit wildlife habitat.
- Work with local government to implement the Public Benefit Rating System and encourage effective use of open space tax incentives for landowners.
- Work with private landowners to identify and protect areas with important habitats and biodiversity and protect these areas through landowner incentives and other nonregulatory programs. Important areas include prairies, oak woodlands, balds, bogs, old growth forest, marshes and undeveloped shoreline.
- Provide educational materials to private landowners that describe management techniques for maintaining and restoring various wildlife habitats.
- Work with private landowners to identify and protect important wetland habitats and buffers by providing adequate water, controlling invasive plants, reducing disturbance to nesting wildlife, and fencing or otherwise keeping livestock out of wetlands and associated upland habitat.
- Influence the application of federal Farm Bill funds, including the Conservation Reserve Program and the WDFW Landowner Incentive Program, on private agricultural lands most critical for wildlife movement and most suitable for restoration of native wetlands, shrub-steppe and grassland habitat.
- Promote grant programs to assist landowners with implementation of management plans.

Improve wildlife conservation education: includes outreach, volunteer and watchable wildlife programs.

- Develop education program targeted to minimizing disturbance of great blue heron colonies during breeding period.
- Develop and/or disseminate education materials to prevent introductions of alien shellfish competitors of western ridged mussel and western pearlshell.
- Develop education program targeted to reduce disturbance of southern resident killer whale, common loon, bald eagle, black oystercatcher, common murre, Cassin's auklet, brant, scaup, and western grebe by boaters, kayakers, fishermen, and low flying aircraft.
- Encourage homeowners to keep cats indoors to protect Mazama pocket gopher, Brush Prairie pocket gopher, gray-tailed vole and Shaw Island Townsend's vole. Distribute literature and web site link to American Bird Conservancy campaign.
- Inform local residents of legal status of Mazama pocket gopher. Promote non-lethal methods of damage control.
- Continue efforts with tribal fisheries to reduce gill entanglement of Pacific harbor porpoise, common murre, ancient murrelet, Cassin's auklet, and tufted puffin.
- Education programs targeting **greater scaup** sensitivity at



important wintering areas in bays and estuaries.

- Develop educational materials and programs targeted to fishermen to reduce lesser scaup mortality from entanglement with discarded line and nets
- Facilitate use of nontoxic alternatives to fishing sinkers to protect loons.
- Use signage or fences to prevent trampling of host plants of sand-verbena moth on public beaches and bog habitats of Beller's ground beetle, Hatch's click beetle and long-horned leaf beetle.
- Engage and involve local and tribal governments, state and federal agencies, organizations and citizens in efforts to protect and restore priority habitats and species through a variety of outreach projects, programs and education efforts.
- Increase the use of citizen science for the collection of data, monitoring, restoration and conservation of important habitats and associated wildlife species. Coordinate volunteer monitoring and involvement.
- Promote and maintain public information and education efforts that focus on endangered species, habitat loss, ecological function, biological diversity and environmentally aware lifestyle practices. Emphasize the connection between habitat and environmental quality and human health and welfare.
- Expand conservation education programs for both adults and children to emphasize the critical nature and vulnerability of sensitive habitats such as wetlands, oak and grassland habitats and associated wildlife.
- Connect with user groups through education to make them part of the conservation solution in areas that have high recreation values.
- Work with large corporations to increase awareness and develop financial support for conservation of biodiversity.



*Male Puget blue butterfly.*